NAVAL AIR WARFARE CENTER TRAINING SYSTEMS DIVISION

2019

RESEARCH COMPENDIUM

Training • Human Performance • Modeling & Simulation

NAWCTSD

Research Mission

- Plan and perform a full range of **research and development,** in support of **Naval training systems** for **all warfare areas** and **platforms**
- Continue to expand the **Naval technology base**
- **Transition results** to the **Fleet** and other customers

RESEARCH COMPENDIUM

2019 EDITION

NAVAL AIR WARFARE CENTER TRAINING SYSTEMS DIVISON

The Naval Air Warfare Center Training Systems Division (Photo Credit: Doug Schaub)

Training ● Human Performance ● Modeling & Simulation

Research & Development to Enable Fleet Success

S&T R&D Where the Mission Begins

A Message from Our NAWCTSD Leaders: Science & Technology to Enable Fleet Success

Captain Timothy Hill USN
Commanding Officer

John Meyers
Technical Director

At NAWCTSD, we conduct research to understand and **improve individual, team, and multi-team learning** and performance. We develop education, training methods, and tools to **reduce training time and maximize transfer of knowledge**, utilizing emerging findings in the **"Science of Learning"** to enable Fleet success.

OUR MISSION

To be the principal Navy center for research, development, test and evaluation, acquisition and product support of training systems, to provide Inter-service coordination and training systems support for the Army, Marine Corps and Air Force, and to perform such other functions and tasks as directed by higher authority.

Near-term Fleet Science & Technology focus areas includes: distributed, Live, Virtual and Constructive (LVC) training; adaptive training; human performance modeling; measurement & assessment; virtual reality and augmented reality training technologies; cyberwarfare and electronic maneuver warfare training; and, rapid prototyping of training technologies.

Our research efforts focus on where the mission begins—where the body of knowledge of human performance and training is expanded, where innovations are developed, concepts are established, and prototypes are demonstrated.

We promote experimentation and creativity, and we encourage our people to challenge basic assumptions. We are open to reinventing ourselves based on new knowledge and understanding. To do this, we work to consistently seek Fleet input and feedback on our projects.

Our ultimate goal is that our training solution innovations are transitioned to the Fleet as quickly as possible to improve warfighter readiness. As part of this process, we lean forward to deliver Fleet prototypes for selected projects that show the greatest promise for transition and Fleet impact.

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Research & Technology Programs Office

Director

NAWCTSD is a key warfare center laboratory for training systems and human performance. The primary goal of our researchers is to explore and develop advanced technologies and methodologies to ensure that the Fleet of tomorrow has the skills, training, and equipment it needs to enable success against current and future threats.

OUR VISION:

To merge behavioral, cognitive and engineering sciences to produce effective training solutions and systems, exploiting technology to improve performance, reduce risk, and reduce cost

OUR STRATEGY:

Partnering with and leveraging work at universities, industry, and other government laboratories, to provide advanced technologies that transition into operational use

Our research focus areas align to our CORE CAPABILITIES:

1. Human Systems Engineering, Integration, and Acquisition
2. Optimized Human Performance and Decision Support
3. Advanced Training Systems Technology
4. Human Systems Analysis, Design, and Evaluation
5. Warfighter Protection, Performance, and Survivability

The Naval Air Warfare Center Training Systems Division (NAWCTSD) is the Navy's source for a full range of innovative products and services that provide complete training solutions. This includes research and development in human performance, learning, advanced technologies through training system acquisition and life cycle support.

NAWCTSD's research mission is to plan and perform a full range of directed Research and Development (R&D) in support of naval training systems for all warfare areas and platforms, to maintain an expanding naval-critical technology base, and to transition research results to the Fleet and other customers.

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Deputy Director
Science & Technology Program Manager

The Department of the Navy's (DON) Science and Technology (S&T) program, includes Basic and Applied Research (BA1 and BA2), and Advanced Technology Development (ATD) (BA3) that is funded and managed by the Office of Naval Research (ONR). The Naval S&T Strategic plan describes how ONR will enable the future operational concepts of the Navy and Marine Corps.

NAWCTSD's S&T Program primarily focuses on supporting the NAE's Naval Warrior Performance Science and Technology Objectives (STOs) that are detailed in the NAE STO document dated April 2014. The NAE STOs directly align to support the Naval S&T focus area called, Naval Warfighter Performance. Other NAE STOs addressed by the S&T project portfolio include: Strike Operations, Undersea Warfare, Information Dominance, and Enterprise and Platform Enablers.

"We revitalize the workforce and enable technical excellence through a focus on research and development."

The Naval Innovative Science and Engineering (NISE) Program was created under Section 219 of the Duncan Hunter National Defense Act for Fiscal Year 2009. It is intended to promote and maintain the scientific vitality of Naval laboratories by funding innovative in-house research in support of military missions, the transition of technology development programs into operational use, and workforce development activities. There are three categories of NISE projects.

The Basic and Applied Research category consists of in-house research projects to explore the fundamental aspects of military relevant phenomena and determine ways in which those phenomena can best be used by the military.

The Workforce Development category of projects is intended more explicitly to build the capability of Naval labs through personnel training and laboratory capability development.

Finally, the **Transition category** provides funding for pre-Milestone A bread board or brass board demonstrations and prototyping efforts to demonstrate critical performance parameters of key technologies.

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Military Deputy
NISE Program Manager

John Hodak

Small Business Research Program Manager

The Small Business Innovation Research (SBIR) & Small Business Technology Transition Research (STTR) programs differ only in the fact that small companies perform exploratory R&D in partnership with universities and larger nonprofit research institutions in the latter program and by themselves in the former.

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Lisa Ouakil

Technology Transfer Program Manager

The NAWCTSD Technology Transfer Program operates under the auspices of the Federal Technology Transfer Act, related laws, executive orders, directives and guidance. The anticipated benefits of sharing the results of Navy modeling, simulation, training, and human performance research and development (R&D) with public and private research organizations are: improved national, state and local training and education, new commercial products and additional national employment opportunities, access to federal government subject matter experts and resources, and feedback on R&D products that can be used to improve future government systems.

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Dani McNeely

S&T Assistant Program Manager
STEM Outreach Coordinator

NAWCTSD supports Department of Defense (DoD) and Navy Science, Technology, Engineering and Mathematics (STEM) goals and priorities. Through Command and ONR funding support, the Program addresses the challenge to educate, train, recruit and retain personnel in STEM critical skill shortfall disciplines for National Security and Defense needs.

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Jennifer Bell

Human Research Protection Program Administrator

The Human Research Protection Program (HRPP) implements NAWCTSD's policies and procedures to protect human subjects involved in research conducted by, for, or through NAWCTSD. Our Institutional Review Board (IRB) was established in 2000 and has the responsibility to protect the rights and welfare of human subjects at potential risk in research projects. NAWCTSD maintains a DoD-Navy Assurance to conduct research.

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RESEARCH
PROJECT
SUMMARIES

CORE CAPABILITY 1:
HUMAN SYSTEMS ENGINEERING, INTEGRATION, AND ACQUISITION

The successful acquisition of training and crew system solutions is highly dependent upon the tailored application of Human Factors, Systems Engineering, and Human Systems Integration (HSI) strategies and processes throughout the acquisition life-cycle. The Department of Defense's (DoD) acquisition policy goal is to optimize total system performance while minimizing the cost of ownership through the development and acquisition management by applying HSI elements to acquisition systems.

HSI establishes the technical framework for delivering crew and training system capabilities to the warfighter. It ensures the effective development and delivery of capabilities through the implementation of a balanced approach with respect to cost, schedule, performance, and risk using integrated, disciplined, and consistent systems engineering activities and processes throughout the acquisition life-cycle to guide knowledge-based product development that demonstrates high levels of performance, protection, and sustainment before significant commitments are made.

The following Technology area comprises this Core Capability: Research, Design and Development of Integrated Human System products.

A HYBRID CLASSIFICATION APPROACH USING DOWN-SAMPLING TECHNIQUES AND TUNED HYPERPARAMETERS ON IMBALANCED DATASETS

OBJECTIVE

The objective of this study is to investigate multiple sampling techniques and hyperparameter settings for a set of machine learning algorithms (MLA) across an imbalanced dataset, specifically for the F/A-18 Environment Control System (ECS)-related memory unit data. This study will develop a model by using down-sampling techniques and tuned hyperparameters on imbalanced sets that yields a high predictive power of Physiological Events (PE).

An F/A-18E Super Hornet, left, from the Argonauts of Strike Fighter Squadron (VFA) 147, and a F/A-18F Super Hornet from the Black Knights of VFA-154 fly in formation past the U.S. 6th Fleet flagship USS Mount Whitney (LCC 20).

PROJECT DURATION

OCT 2017 - SEP 2018

FUNDING SPONSOR

Naval Air Systems Command (NAVAIR) | Section 219

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DESCRIPTION

The field of machine learning continues to grow and show promising capabilities, however, there are still some shortcomings that need to be addressed. One of the most pressing shortcomings of applying Machine Learning Algorithms (MLA) to real world problems is the lack of performance on imbalanced data sets. While research has shown that sampling techniques and tuning the hyperparameters of MLAs can improve their performance, there still remains a gap in the literature on whether the bias of the majority class can be overcome. This research shall test the hypothesis that a hybrid approach would best reduce the inherent bias of the majority class while conserving its intrinsic information.

NEED

There are current problems in the fleet, such as the incidence of PEs within NAVY F/A-18 platforms and the T-45 which have not been solved and are actively impacting fleet readiness. Effective analysis of imbalanced data sets could have immediate impact on these problems. Most real-life problems are always imbalanced in their data. Therefore, it is imperative that methods of imbalanced dataset analysis be investigated to further understand how to best mitigate the majority class bias without losing too much from the majority class.

BENEFITS

The results of this study will contribute immediately to NAVY F/A-18 PE analysis. PE occurrences are a minority class in the population of all flights. Therefore, advancements in techniques for analyzing imbalanced datasets would benefit the analysis of PE-related data and enable analysts to better understand the differences between these flights and normal flights. The knowledge obtained from imbalanced datasets can also be applied to future Navy training solutions to improve training effectiveness. Furthermore, as the reliance on data within the NAVY increases better approaches and techniques will be of high importance in order to extract the necessary information to accurately inform management of what the data is saying.

STATUS

In FY18 the team established the required testbeds and prepared the required data sets for experimentation. Evaluation of hand tuned sub-sampling techniques showed improvement in classification accuracy. FY19 will continue with the evaluation of auto sampling techniques and experimentation of generative networks to augment the minority class with artificial samples. Results shall be documented in subsequent reports.

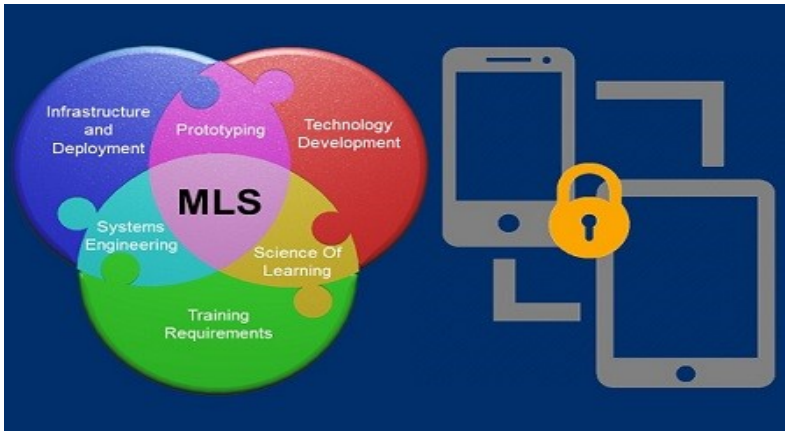
MILESTONES

- Extend sampling techniques to auto-generation algorithms and evaluate their performance (2nd Qtr FY19)
- Conduct performance trade-off study between the number of artificial examples within the minority class and model performance (3rd Qtr FY19)
- Author Technical reports of overall findings and lessons learned (4th Qtr FY19)

DEPLOYING MOBILE DEVICES FOR NAVY TRAINING: LOW-COST MOBILE DEVICE MANAGEMENT ALTERNATIVES

OBJECTIVE

Gain detailed technical expertise to develop NAWCTSD smart buyer awareness in the field of Mobile Device Management (MDM) - a critical technology for adopting and promulgating mobile devices throughout Navy training. Perform a case study to determine the minimum technical characteristics required of an MDM that would allow Navy schoolhouses to fully incorporate low-cost mobile devices into military training classrooms while adhering to DoD and DoN Cybersecurity mandates.



The NAWCTSD Modern Learning Strategies (MLS) team helps organizations implement modern technologies for learning by operating within the union of the disciplines shown above. This project will expand NAWCTSD/MLS workforce knowledge, technical expertise, and smart buyer awareness in the field of Mobile Device Management (MDM) - a critical technology for adopting and promulgating mobile devices throughout Navy training.

PROJECT DURATION

OCT 2017 - SEP 2018

FUNDING SPONSOR

Naval Air Systems Command (NAVAIR) | Section 219

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DESCRIPTION

NAWCTSD engineers believe that by applying new technical capabilities (such as scoping mobile device management features to reduce complexity, and devising compensating controls to meet Cybersecurity mandates), the per student cost to provide mobile devices in Navy classrooms can be reduced to an amount comparable to the cost of printing paper-based curriculum. Achieving this cost would allow immediate fielding of tablets to schoolhouses using currently allocated budgets and available funds, and the lessons learned will facilitate wider adoption and availability of mobile technologies for training and data visualization across the Navy.

NEED

NAWCTSD engineers participating on Integrated Product Teams (IPTs) where mobile technology is being considered do not currently have the requisite knowledge to accurately assess level-of-effort or recommend cost-saving technology alternatives.

BENEFITS

Fielding tablets on a Navy network using Government-owned technologies in a manner that is reproducible, and then proving its efficacy in the Navy schoolhouse environment, opens the door to rapid adoption of tablet technologies for training applications across the Navy. Potential areas of applicability include: autonomy, UAS / Counter UAS training, big data representation for maintenance decision making, wider application of Ready Relevant Learning principles, etc.

STATUS

This project was completed in FY18. The knowledge gained in this effort was documented in an Actionable Roadmap that directly informs a follow-on in-house development effort to obtain and certify a Mobile Device Management and Information Protection framework for Navy schoolhouses, with the goal of making the technology available to training initiatives across the Navy.

MILESTONES

- Through the research required to perform this effort, the participating workforce members gained experience in the areas of Mobile Device Management, Information Protection, and associated Cybersecurity policies related to connecting and certifying mobile devices on Navy computer networks.
- The deliverables that were produced to document and capture this knowledge gain are:
  - Commercial-Off-The-Shelf (COTS) Mobile Device Management (MDM) feature priority list
  - Risk Management Framework (RMF) controls and compensating controls list
  - Actionable Roadmap
  - Proof-of-concept software source code and associated documentation to inform NAWCTSD IPTs performing future acquisition/development efforts.

MULTI-INTEGRATED DOMAIN ADMINISTRATIVE SUPPORT SOLUTION

OBJECTIVE

Design and develop a cross-domain solution (CDS) technology that allows a centrally located system administrator to disseminate network configuration information to multiple associated networks.

The Department of Defense effort to enhance and combine its computer networks to improve capability and reliability

PROJECT DURATION

SEP 2018 - MAY 2019

FUNDING SPONSORS

Naval Air Systems Command (NAVAIR)
NAVAIR Small Business Innovative Research (SBIR)

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DESCRIPTION

One of the core security features of distinct information networks is that they are separate from other computer networks. This is primarily implemented to ensure that if one is compromised, the other remains unaffected as access to the network is limited and restricted by an administrator. This effort focuses on designing, developing, and demonstrating the feasibility of a proof-of-concept cross-domain administrative solution and network communication between trusted and untrusted networks.

NEED

Although the cyber security benefits of individual networks are clear, there is a desire for a secure CDS to allow a central system administrator to manage multiple networks. Cross-domain solutions provide the ability to transfer information between two domains with different security levels that are isolated from each other. Currently, each network administrator must set up separate instances for their own respective domains, which poses software-related concurrency challenges. The desired solution is envisioned as a standalone solution, or a technology that can be added to an existing cross-domain solution for network communication between trusted and untrusted networks. Key factors of an envisioned solution include the scalability of architecture and the supportability of the device.

BENEFITS

Having the ability to manage all domains with a single cyber security solution (through a specialized guard) would significantly lessen both the initial acquisition and sustainment costs of any procurement that had the requirement for multiple classification levels. or design solution tradeoffs of comparative technologies.

STATUS

NAWCTSD personnel conducted Phase I evaluations over the summer of 2018. The performer held a kickoff meeting with NAWCTSD in late September 2018. The performer identified feasibility solutions and are producing early prototypes.

MILESTONES

- Phase I:
  - Proposals from vendors based on solicitation were evaluated for technical approach, qualifications, and commercialization strategy in summer 2018
  - Cross-code project team comprising research psychologists and interoperability engineers will monitoring was completed via bi-monthly progress reports and periodic status updates
  - FY19 efforts will focus on developing a prototype system to evaluate in a test domain

NEXT GENERATION TRAINING SYSTEMS DEVELOPMENT FOR MANNED & UNMANNED CONCEPTS

OBJECTIVE

Develop workforce skills in individual & team level training concepts that apply to future concepts for manned-unmanned team training environments including implementation of artificial intelligence, development of trust in automation in training, & applications for data science for performance assessment/effectiveness analyses.

The JMR-TD is demonstrating platform and mission systems technologies to help the Army make decisions about FVL capabilities, which could look like this hypothetical rendering. The demonstrator effort is managed jointly by a team led by the U.S. Army Aviation and Missile Research, Development and Engineering Center (AMRDEC). (U.S. Army graphic by AMRDEC VizLab)

PROJECT DURATION

AUG 2018 - SEP 20

FUNDING SPONSORS

Naval Air Systems Command (NAVAIR)
Small Business Innovative Research (SBIR)

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DESCRIPTION

This effort seeks to develop workforce skills in individual & team level training concepts that apply to future concepts for manned-unmanned team training environments including implementation of artificial intelligence, development of trust in automation in training, & applications for data science for performance assessment/ effectiveness analyses.

NEED

As the Navy seeks to adopt novel aviation platforms such as Future Vertical Lift, which strives to maximize automation and manned-unmanned teaming solutions, there is a need to address training strategies and technologies ability to support the required training. Specifically, expanding on existing instructional strategies, modalities, and training technologies to advance individual and team training will be necessary to address the emerging needs of future concepts for manned-unmanned team training environments.

BENEFITS

Through the early involvement of instructional system designers and research psychologists, this effort seeks to identify capability and technology gaps that can be pursued via science and technology development efforts ahead of platform fielding.

STATUS

Cross-organization meetings were held to discuss Army technology development and concepts to date. A research and development roadmap that highlights Joint service science and technology efforts for platform development and training solutions is under development.

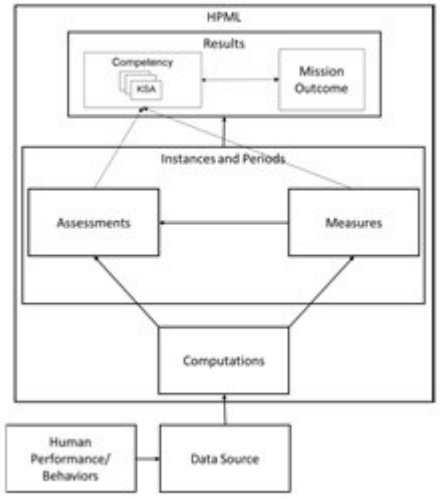
MILESTONES

- Workforce Development: Mentored junior teammates on procurement process and pre-Milestone A opportunities for training. Cross-organization collaboration provides opportunities to develop workforce skills in individual and team level training concepts.

SIMULATION STANDARDS FOR INTEROPERABILITY OF HUMAN PERFORMANCE AND DEBRIEF DATA IN TRAINING

OBJECTIVE

This project aims to provide a multi-disciplinary team with a Navy Standards and Human-in-the-loop voice in the process of developing an overall standard that Navy, Joint, coalition partners, and industry will comply with to enable training systems across the spectrum to be interoperable through participation in Simulation Interoperability Standards Organization (SISO).



The Human Performance Markup Language (HPML) standard provides schemas for organizing information relevant to performance including: Computations, Measures, Assessments, Results, and Instances and Periods.

PROJECT DURATION

OCT 2017 - SEP 2019

FUNDING SPONSOR

Naval Air Systems Command (NAVAIR) | Section 219

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DESCRIPTION

Product Development Groups (PDGs) are collaborative opportunities for organizations (e.g., Department of Defense, North Atlantic Treaty Organization, industry, academia) to build consensus among members and refine standards that result in formal adoption by the Simulation Interoperability Standards Organization (SISO). This effort seeks to provide resources for a multi-disciplinary team of engineers and human factors professionals to actively participate in the Human Performance Markup Language (HPML) and Distributed Debrief Control Architecture (DDCA) PDGs.

NEED

Developers are currently challenged with finding ways to implement technology in environments that lack the right type of data. The technology challenge that exists is defining a means for implementing performance measures and an architecture for debriefing that increases their successful integration, and ensuring that Navy requirements are articulated and advocated for, during the industry standards development process.

BENEFITS

Interoperability is essential to supporting training in an integrated, interactive environment. Early participation in standards development ensures that the Navy's requirements are represented and that we maintain awareness of novel developments by other SISO members that may benefit our Science and Technology, Research and Development, and/or acquisition. Further, calls for quantitative data and big data analytics to understand proficiency requires access to the right data. Therefore, it is imperative to ensure that distributed training environments support assessment of performance and provides an architecture that facilitates distributed debriefs.

STATUS

Teammates reviewed the status of current PDG products, and participated in the 2017 Simulation Innovation Workshop held in January 2018, as well as the 2018 Simulation Innovation Workshop held in September 2018. In FY19, the team will attend additional meetings and quarterly meetings to inform and vote in the HPML PDG.

MILESTONES

- Manuscripts/Publications:
  - Atkinson, Tindall, Killilea, Tolland, & Dean. (2017). Standardizing human performance measurement for ease of data analytics. Proceedings of the I/ITSEC. Paper received honorable mention for 2017 IITSEC Best Paper.
  - Manuscript entitled Standardizing Performance Measurement While Ensuring Psychometric Validity in progress.
- Workforce Development: Mentored junior teammates on simulation interoperability and automated performance measurement.
- Transitions: The proposed HPML is the underlying code base for efforts such as the PMATT-TA Performance Dashboard, providing a use case and testing standard as part of the transition of technologies to PMA-290 and PMA-205.
- Collaborative Mechanisms/Agreements: Coordination across research psychologists and interoperability engineers supports a multi-disciplinary perspective on standards under development. Collaboration amongst industry, government and academia has been achieved through participation in HPML PDG meetings.

CORE CAPABILITY 2:
HUMAN SYSTEMS ENGINEERING, INTEGRATION, AND ACQUISITION

Current and future Naval systems are not only dependent on the qualities of the systems and the performance of their operators, but are also highly dependent upon the interaction between the human and the system. Failure to effectively integrate the human and the system invites mission failure. It is routinely reported that 70-80% of all aviation and other mishaps trace back to human error in some fashion.

The overwhelming majority of these errors are related to inaccurate decisions, judgments, and perceptions, attributable to inadequacies in the systems design or decision-support capabilities. The extent to which those same design and/or decision support inadequacies contribute to operational inefficiencies or outright decrements is not as clearly quantified, but is expected to be profound.

Human Performance refers to the range of perceptions, decisions, and actions that an individual or team carries out in the context of performing a task. The underlying detail in each of these actions traces back to the design of systems and the training of operators. Human Performance Assessment (HPA) focuses on the ability to accurately measure and analyze task performance at different levels which include individuals, teams, multi-teams, and organizations. HPA can be conducted across multiple domains and tasks, ranging from simple procedural skills to complex cognitive skills, such as tactical decision-making, and is an integral part of Human Performance Modeling (HPM). Measurement technologies encompass neurocognitive, as well as other physiological measures or indices. Better understanding of such measures in the context of training or operational tasks will serve both to expand this technical area and to enhance warfighter performance and effectiveness.

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While there is already a clear adverse impact resulting from the lack of / flawed human systems design and decision support, there is also a significant concern that this will be rapidly exacerbated due to the overwhelming amount of data being collected and available in a timely fashion. For human decision-makers to be effective in these information-rich environments, "they must be able to access the data necessary to make a decision when, where and in a manner that addresses the need. The data must be integrated and organized so that they become useful information to the user" (Morrison et al., 1998, p. 375). The challenge of integrating the human and system can be parsed into four separate pieces: 1) human factors engineering—which is required for the system to be used effectively by the human operator, 2) HMIs specifically developed to supplement the human's ability to process, infer, and decide in real time actions based on system-provided information, 3) developing the requisite training materials of modes of presentation to optimally use the information to make and implement better, faster decisions, and 4) automation to perform functions without direct human intercession.

The following Technology areas comprise this Core Capability:

Human-Machine Interfaces
Human Performance Measurement and Assessment
Training Methodologies for Distributed Team Competencies
Advanced Instructional Techniques
Applied Human Behavior Modeling

ADAPTIVE TRAINING SYSTEM FOR MAINTAINING ATTENTION DURING UNMANNED AERIAL SYSTEMS (UAS) OPERATIONS

OBJECTIVE

The purpose of this effort is to develop an innovative and adaptive training system for Unmanned Aerial Systems (UAS) operators to maintain attentiveness during the long shiftwork associated with extended UAS missions. The initial call (for proposals) was made for cost-effective, computer-based, simulation training solutions that are able to adapt to the 1) learning characteristics of different individuals, 2) affordances inherent in UAS, and 3) specific details involved with different missions.

The MQ-4C Triton unmanned aircraft system prepares to land at Naval Air Station Patuxent River, Md., after completing an approximately 11-hour flight from Northrop Grumman's California facility. (U.S. Navy photo by Kelly Schindler/Released)

PROJECT DURATION

OCT 2016 - SEP 2019

FUNDING SPONSOR

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Small Business Technology Transition

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DESCRIPTION

With the expanding use of UAS comes the increasing need for UAS operators to maintain attention for long periods of time during the missions. Shifts of up to 12 hours in length are not uncommon. Shiftwork is associated with higher fatigue levels, degraded task performance, and higher error rates. While existing UAS simulations aim to train operators on job-related skills, there are currently no systems that focus on attention. This research aims to develop tailored adaptive training techniques to minimize the issue of channelized attention. Training techniques capable of presenting long term mission requirements also need to be developed, as no such technology currently exists.

NEED

Channelized attention occurs when all of an individual's cognitive resources are focused on one aspect of the environment, causing other equally important cues to be missed. Investigations of larger group 4 and 5 UAS mishaps have indicated that issues with channelized attention contributed to the mishap(s). Thus, it is critical to provide training for UAS operators on how to maintain attention over extended periods of time.

BENEFITS

Research on attentional training has indicated that it is possible to train attention and create effects that transfer to tasks after training. Moreover, attentional training may be more effective if it is adaptive. Adaptive training is broadly defined as any instruction that is tailored to an individual trainee's strengths and weaknesses, so that the training experience varies from one individual to another based on task performance, aptitudes, or test scores. The goal of adaptive training solutions is to provide the effectiveness of one-on-one tutoring through computer-based training that does not require an instructor in the loop. Thus, such training can possibly reduce the likelihood of UAS mishaps via a cost-effective method.

STATUS

Following the end of the Phase I Base period, two companies moved forward, via a gated approach, to the Phase I Option and Phase II Base periods. The Phase II Base period recently ended, and a down-select decision is underway prior to the beginning of the Phase II Option. In this Option period, the selected company will develop individual test subject baselines and–post-training–perform an effectiveness evaluation to demonstrate the improved attention of UAS operators.

MILESTONES

- Selected 4 companies from more than 25 to perform during the Phase I Base Period
  - Companies completed the Base period of Phase I, in which they designed, developed, and demonstrated a proof of concept for adaptive training techniques and a computer based simulation trainer to improve operator attentiveness during long shift work.
- Selected 2 of the 4 companies for gated approach to Phase II Base
  - Companies completed Phase I Option & Phase II Base periods, in which they refined the systems, developed mission scenarios, further defined system adaptive training elements, and obtained Institutional Review Board (IRB) approval in preparation for experimental investigations of system effectiveness.

ADJUSTABLE CREWMEMBERS - ACCELERATING INSTRUCTOR MASTERY (AIM)

OBJECTIVE

This effort will design, develop, and demonstrate a suite of synthetic crew members, who operate in support of Tactical Coordinator (TACCO) training in the Anti-Submarine Warfare (ASW) domain, capable of dynamically adjusting their performance to better fit the needs of the trainee during part-task training activity.

A member of VP 5 plans radar search tactics onboard a P-8A Poseidon aircraft during a sea search and rescue operation off the coast of Argentina. (U.S. Navy photo by Mass Communications Specialist 2nd Class Sean R. Morton/Released)

PROJECT DURATION

MAR 2018 - APR 2020

FUNDING SPONSORS

Naval Air Systems Command (NAVAIR)
NAVAIR Small Business Innovative Research (SBIR)

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DESCRIPTION

The Adjustable Crew Members effort is focused on further augmenting the baseline Crew Role-Players Enabled by Automated Technology Enhancements (CREATE) technology suite that brings advanced speech recognition and intelligent agent behavioral modeling in to the P-8A part-task training. It will enable synthetic crew members to dynamically adjust their performance to better fit the needs of the trainee and instructor during TACCO-centered part-task training activity.

NEED

The successful transition of autonomous crewmembers technology seeks to solve a long-standing training challenge - how to train a single trainee in a task that requires a crew or group to execute it. Through a software solution for autonomous crewmembers that builds on recent technological advances in speech recognition, this technology capability has the potential to reduce operator workload and facilitate more robust and realistic training of skills such as crew coordination earlier in the training pipeline. The Adjustable Crew Member effort allows instructors to better tailor the intelligent agent's domain awareness and expertise to the individual TACCO trainee.

BENEFITS

Adjustable and customizable intelligent and autonomous crew member agents will allow for more realistic and robust early TACCO training. As much of the TACCO role focuses on being the nexus of information, building communication and coordination skills early during individual training is a key motivator. By leveraging realistic crew member agents, the instructors can focus on driving the scenario and providing timely and appropriate feedback to the trainee, rather than having to role-play the various sensor roles.

STATUS

This effort was selected for Phase 2 award as a FY18 new start. First year tasking will focus on modifying three crew member models (acoustic operator, electronic operator, co-TACCO) so that they can adjust their performance and proficiency in response to internal or external stimuli. Future tasking will include modifying the agents to support automatic (or cued) performance degradation, as well as designing the instructor interface for these actions to be instantiated.

MILESTONES

- Phase II:
  - NAVAIR awarded a Phase II contract to a single vendor based on progress made during an Office of Naval Research SBIR and maritime patrol program interest
  - The Phase 2 kickoff will bring together P-8A Fleet Projects personnel, Fleet Training personnel, as well as members of the P-8A Innovation Council
  - Future tasking in FY19 will include modifying the agents to support automatic (or cued) performance degradation, as well as designing the instructor interface for these actions to be instantiated.

AVIATION RECONFIGURABLE COCKPIT FOR HYPOXIA & HAZARD EXPOSURE & RECONGITION (ARCH2ER)

OBJECTIVE

To research, develop, and testing of a reconfigurable and modular cockpits and controls for aviation pilot training that are low -cost but moderate fidelity to support immersive training devices.

Aviation survival training seeks to advance mishap awareness training through interactive, immersive visualization techniques such as moderate fidelity training systems.

PROJECT DURATION

OCT 2018 - SEP 2020

FUNDING SPONSORS

PMA-273; Naval Air Systems Command (NAVAIR) Small Business Innovative Research (SBIR)

POINTS OF CONTACT

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DESCRIPTION

This effort seeks to evaluate the feasibility of a reconfigurable training system to provide higher fidelity emergency procedure training in aviation survival training centers, fleet synthetic or Live Virtual Constructive (LVC) training centers (configure to needed platforms for next training exercise), and deployed training sites with limited space and multiple T/M/S in the area.

NEED

As the Navy seeks to identify ways to provide low-cost, high fidelity training options with a family of training systems, novel solutions such as augmented reality are under investigation. One potential way to capitalize on the benefits of this flexible training medium for aviation training is the use of replica cockpits and controls to provide high physical fidelity during training. However, to maximize the benefit, low-cost equipment that is reconfigurable to different type/model/series (T/M/S) platforms would allow for flexibility for training multiple types of aircrews.

BENEFITS

Development of a reconfigurable cockpit training solution provides an opportunity to increase training fidelity at locations where aircrew from multiple platforms are trained while minimizing costs and footprint requirements when compared to platform specific training solutions. Additionally, by advancing the fidelity of hardware cockpits and controls, while seeking to minimize costs, this effort provides initial research into solutions that may increase the feasibility of augmented reality training.

STATUS

A Phase III contract was awarded in September 2018 to focus on the design and development of an initial reconfigurable cockpit, development of an intuitive instructor operator station, and the test and demonstration of resulting prototypes.

MILESTONES

- Workforce Development: Mentored junior teammates on program management and contract package development
- Presentations: Demonstration exhibit at IITSEC 2018.
- Transitions: Efforts focus on transition to PMA-273 to support enhanced fidelity of training for physiological episodes, as well as the Naval Survival Training Institute.

USER INTERFACE STRATEGIES FOR HUMAN-MACHINE TEAM TRAINING IN A SIMULATED SWARM TASK

OBJECTIVE

This project will compare the impact of multiple innovative display strategies on human-machine team training within a simulated multi-unmanned system scenario (i.e., swarm). Results will inform ongoing efforts to define user interface requirements for operator control of multiple, unmanned systems, as well as empirical evaluation of state diagrams and task-based interfaces to facilitate human-machine team training for swarm-based tasks.

Drone Swarm Illustration

PROJECT DURATION

OCT 2017 - SEP 2019

FUNDING SPONSOR

Naval Air Systems Command (NAVAIR) | Section 219

POINTS OF CONTACT

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DESCRIPTION

Through a continued collaboration with the Robotics and Intelligent Systems Engineering (RISE) Lab (Lakehurst) and NAWCTSD (Orlando), we will develop a simulated environment (i.e., prototype) whereby one operator will coordinate with multiple unmanned (ground and/or air) systems to execute ISR tasks. In a mixed factorial design, we will compare state-based diagrams and task-based interfaces to a default condition, in terms of human-machine team performance, operator mental workload and situation awareness.

NEED

This proposal aligns with multiple 4.6 Core Capabilities as outlined in the "Core Capabilities and Future Directions: Human Systems Department (AIR-4.6)" document. AIR-4.6 emphasizes "research, design, and development of human systems products." Specific capability development will be realized through "functional allocation and integration of advanced interaction technologies such as automation, decision aiding and data fusion."

BENEFITS

Autonomous systems are expected to produce extensive benefits to manpower, military capabilities, and mission success in future years, with the Department of Defense placing a high priority on continued research and development of these technologies (DOD Unmanned Systems Roadmap: 2013-2038).

STATUS

This project was started in October 2017. During FY18, design & experimental requirements have been completed, prototype development is ongoing, and IRB review has been completed. FY19 will focus on final prototype development, experimental testing, and analysis/reporting of results.

MILESTONES

- Completed experimental plan and high-level prototype requirements
- Completed IRB submission and review
- Complete prototype development by FY19 Q2
- Conduct experiment and analyze/report findings by end of FY19

VARIABLE ACCOMODATION HEAD MOUNTED DISPLAY

OBJECTIVE

The primary objective of this program is to overcome the vergence-accommodation conflict and fatigue in head worn displays.

Screenshot of the proposed virtual test environment.

PROJECT DURATION

DEC 2017- DEC 2019

FUNDING SPONSOR

Naval Air Systems Command (NAVAIR) | Section 219

POINTS OF CONTACT

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DESCRIPTION

The proposed technology incorporates variable accommodation into the HMD to eliminate the conflicting cues and decrease fusion time of binocular imagery and accuracy. The project will leverage the Variable Collimation Display (VCD) technology developed under the current NAVAIR SBIR topic N121-041 Phase II program. Specifically, the VCD's Variable Adaptive Lens (VAL) technology, control electronics and software will be adapted to fit in a thin, wide field-of view format conformal with the shape of current head worn displays. The VAL will be integrated in a head worn displays in order to stimulate accommodation-vergence response in the user, thus improving an enhanced immersive experience.

NEED

Virtual reality deployable trainers employ head worn displays technology to reduce the trainer footprint and provide a fully immersed training experience. However, accommodation depth cues (i.e., focus) are currently not replicated in current head worn displays. Instead, the eye is forced to focus on a fixed image plane regardless of the object location, resulting in a vergence-accommodation conflict. This limitation hinders the user's ability to accurately judge distances, reduces the user's sense of immersion and can cause or exacerbate virtual reality sickness (eye strain, dizziness, etc.).

BENEFITS

The anticipated benefits and potential commercial applications of the research and development into high-resolution wide-field-of-view head worn displays with variable accommodation include: (i) improvement in users' immersion; (ii) reduction in Virtual Reality (VR) sickness (eye strain, dizziness, etc.); and (iii) improve spatial awareness and more accurate judgement of depth and image distance.

STATUS

The two two-year program is partitioned into four 6-month phases, or "Spirals". Each Spiral results in an iteration of the prototype. These prototypes are delivered for testing. Spiral one was completed and the VAL system was tested b using 10 participants. A list of recommendations were provided that will aid the development of the Spiral 2 HWD design.

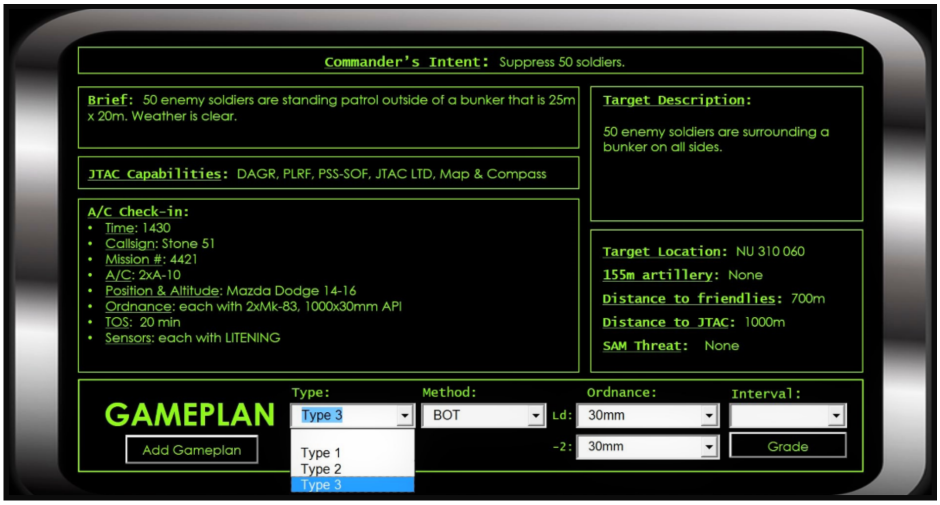
MILESTONES

- Manuscripts/Publications: Batchko, R., Robinson, S., Schmidt, J., & Graniela, B. (2014, March). A variable-collimation display system. In Proc. SPIE (Vol. 9011, p. 901109).
- Presentations: Spiral 2 (Month 6) Design Review 8/21/18

ADAPTIVE TRAINING FOR USMC CLOSE AIR SUPPORT TACTICS AND DECISION-MAKING

OBJECTIVE

The goal of this effort is to perform systematic research on the efficacy of adaptive training (AT) for a complex decision-making task centered on the Joint Terminal Attack Controller (JTAC). Specifically, the AT testbed focuses on game plan development, a critical planning task that sets the stage for the execution of a Close Air Support mission and a challenging topic for JTAC trainees to master.



PROJECT DURATION

DEC 2016 - DEC 2019

FUNDING SPONSOR

Office of Naval Research (ONR)

POINTS OF CONTACT

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DESCRIPTION

Adaptive training (AT) is training that is tailored to an individual's strengths and weaknesses, and it has led to higher learning gains and decreased training time when compared to traditional training approaches in certain domains. However, more systematic research is needed to determine which AT techniques to employ, when to employ them, for what content to inform best practices, and when to invest in AT technologies. This research will examine the benefits of two particular AT techniques (i.e., adapting feedback and scenario difficulty) based on trainee performance in a scenario-based Close Air Support (CAS) decision-making task (e.g., game plan development) for Joint Terminal Attack Controllers (JTACs).

NEED

USMC Vision and Strategy 2025 and ONR's Science & Technology (S&T) Strategy for Warfighter Performance both highlight the need for tailored training that focuses on the individual learner. Adaptive training is well-suited to meet this demand.

BENEFITS

Additionally, this research will inform the military training community on AT best practices. This research has the potential to optimize classroom training time by allowing students the opportunity to practice key CAS skills on an individual basis, freeing up instructor time to focus on more challenging topics with the class.

STATUS

In FY18, there are two main thrusts of work planned. For Thrust 1, the team will continue to improve the ATTAC prototype by refining the assessment, feedback, and scenario difficulty algorithms and developing new scenarios. This thrust requires close collaboration with JTAC subject matter experts to ensure that the scenarios have appropriate face and content validity. For Thrust 2, NAWCTSD plans to conduct an experiment to test different schedules of feedback and scenario difficulty adaptations, which requires developing experimental materials and receiving IRB approval.

MILESTONES

- Attended Tactical Air Control Party (TACP) courses at Expeditionary Warfare Training Group (EWTG) Atlantic and Pacific to observe JTAC training and interview instructors to determine the topics with which trainees have difficulty
- Based on these observations and interviews, selected game plan development as the training content area
- Developed Adaptive Training for Terminal Attack Controllers (ATTAC) prototype. ATTAC:
  - Displays scenarios and assesses performance
  - Contains a working scenario difficulty algorithm that adjusts based on performance
  - Contains a preliminary working feedback algorithm that provides feedback tailored to an individual's response
- Created 20 unique scenarios with input from subject matter experts

DATA SCIENCE DRIVEN AIRCREW PERFORMANCE MEASUREMENT AND PROFICIENCY SYSTEM

OBJECTIVE

Develop a software technology to pre-process, fuse, and store data from multiple sources for human performance assessment and proficiency tracking during training, with the capability to parse and synchronize disparate data from live, virtual, and constructive aviation training system sources to output automated performance metrics.

150903-N-SS390-266 FALLON, Nev. (Sept. 3, 2015) F-35C Lightning IIs, attached to the Grim Reapers of Strike Fighter Squadron (VFA) 101, and an F/A-18E/F Super Hornets attached to the Naval Aviation Warfighter Development Center (NAWDC) fly over Naval Air Station Fallon's (NASF) Range Training Complex. VFA 101, based out of Eglin Air Force Base, is conducting an F-35C cross-country visit to NASF. The purpose is to begin integration of F-35C with the Fallon Range Training Complex and work with NAWDC to refine tactics, techniques and procedures (TTP) of F-35C as it integrates into the carrier air wing. (U.S. Navy photo by Lt. Cmdr. Darin Russell/Released)

PROJECT DURATION

JUN 2018 - MAY 2021

FUNDING SPONSORS

Naval Air Systems Command (NAVAIR)
Small Business Innovative Research (SBIR)

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DESCRIPTION

This effort seeks to design and develop an architecture and process for linking available data sources to tactical aircrew performance in warfighting capabilities based on fleet tactical recommendations and mission essential tasks references, that is flexible to incorporate future tactics and scalable to address individual to multi-team performance. The team will work to determine the feasibility of implementing a software-based solution to process, parse and fuse disparate data sources and types for a single platform, as well as design advanced data science approaches intelligence for automated and human-in-the-loop data output for performance assessment, facilitating feedback, and support longitudinal trend analysis computations.

NEED

The current state-of-the-practice for performance assessment relies heavily on subjective rating, which is hampered by a manually intensive and time-consuming process. A software tool that provides an automated mechanism to pre-process and fuse multiple data sources for human performance assessment and proficiency tracking in warfighting capabilities would alleviate this burden. Specifically, to develop computational methods that can assist with timely and continuous calculation of aircrew performance, proficiency and identify associated trends.

BENEFITS

Better feedback to aircrew will improve performance by identifying training gaps. Increased quantities of data on aircrew performance will enhance future mission capabilities by informing decisions on training resource requirements. This effort seeks to close debrief and reporting gap identified by recent analyses of existing large force exercises. This gap will be present in and increasingly relevant to the effectiveness of forthcoming distributed simulation and LVC training events.

STATUS

This SBIR has undergone competitive source selection resulting in multiple Phase I awards. The team is currently conducting closeout briefings and will conduct an extensive review of Phase I work to determine invitations for Phase II full proposals and awards.

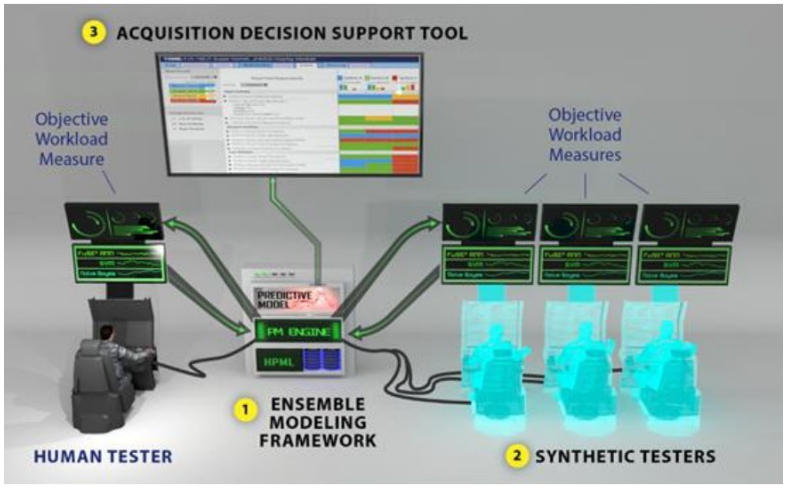
MILESTONES

- Phase I:
  - Kickoff meetings were held with each of the three Phase I contractors
  - Contractors status was monitored via bi-monthly progress reports and periodic status updates
  - Closeout briefs are being scheduled with each of the contractors to discuss Phase I progress and Phase II plans
  - Phase I Option decisions and awards are expected Nov 2018
- Phase II:
  - Phase II decisions and awards are expected Dec 2018

METHODS FOR ACTIONABLE MEASURES OF ABSOLUTE COGNITIVE WORKLOAD

OBJECTIVE

To develop an innovative and cost-effective capability that will provide an objective, measurable means of workload for determining impacts on individual operator, crew-level, and/or multi-team system level performance when life support or aircrew systems are added or modified.



Aptima's Tools for Objective Measurement and Evaluation applied to a notional T&E environment.

PROJECT DURATION

OCT 2014 - DEC 2018

FUNDING SPONSORS

Naval Air Systems Command (NAVAIR) | Small Business Technology Transition

POINTS OF CONTACT

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DESCRIPTION

In the Naval community, improving affordability is one of the main focus areas. Specifically, standardized workload management systems have been deemed one essential component to gain increased affordability. It is critical to know human performance limitations when introducing complex/cognitive tasks, state-of-the-art technologies/equipment, and new environments to warfighters. Knowledge of these limitations can help researchers and developers understand and evaluate the potentially negative impacts on safety and the efficiency of operations. This effort develops a hybrid approach to objectively assess aircrew workload.

NEED

Current state-of-the-practice is to assess workload, either physical or cognitive, through a variety of assessment methods. The most commonly implemented are subjective measurement techniques; however, there is an increased desire for more objective data on which to base decisions. A variety of objective measurement techniques exist for cognitive workload including performance measures. New, cost-reducing methods are needed to support systems acquisition decisions, and these will need to improve on existing methods.

BENEFITS

This effort seeks to investigate a hybrid approach that would allow for the real-time measurement of physical and cognitive workload using results and modeling capabilities to understand how variations in the associated factors might impact operator safety and performance.

STATUS

In FY18, two industry partners were down-selected and awarded 9 months for the gated approach. During this time, multiple systems evaluating workload (i.e., sensors, algorithms, user interface) were designed and demonstrated. Currently, workload data is being collected utilizing the suite of tools to fine tune the algorithms. FY19 will consist of a selection of one awardee after the completion of the base period and final prototype feasibility.

MILESTONES

- Phase I:
  - Kickoff meetings were held with each of the Phase I contractors, and contractors status was monitored via bi-monthly progress reports and periodic status updates
  - Closeout briefs were held with each of the contractors to discuss Phase I progress and Phase II plans
  - Phase I Option was awarded for two vendors
- Phase II:
  - Phase II gated efforts were awarded for two vendors, holding kickoff meetings and periodic reviews of prototype toolkits
  - Status was monitored via quarterly progress reports and monthly status call updates
  - Institutional Review Board (IRB) approval for data collection was completed

TECHNIQUES TO ADJUST COMPUTATIONAL TRENDS INVOLVING CHANGING DATA (TACTIC-D)

OBJECTIVE

Develop technology based on statistical or computational methods to assist in the continued tracking of training performance and proficiency trends as underlying tactical data changes.

Racks containing Naval Integrated Tactical-Cloud Reference for Operational Superiority (NITROS) capabilities.

PROJECT DURATION

SEP 2017 - SEP 2020

FUNDING SPONSOR

Naval Air Systems Command (NAVAIR)
Small Business Technology Transition (STTR)

POINTS OF CONTACT

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DESCRIPTION

The continued push for integrated warfare will likely result in cross-platform, mission-based trends; however, there may be differences in constructs across platforms (e.g., one platform may rely on timeliness and another on accuracy) that if not accounted for in the analysis or development of common construct definitions would skew analysis results. This effort seeks to identify statistical or computational methods that can assist with these adjustments to statistical trends, and implement them in an automated tool that will allow for the timely and continued calculation of trends related to fleet performance and proficiency.

NEED

The DoD and USN seek to leverage the benefits of qualitative data analytics for tactical proficiency assessment to support decision making. Military domains for big data is unique in that the tactics, techniques and procedures used by the fleet shift over time due to changes in capabilities or the need to adapt, creating a unique challenge for the typical statistical processing to ensure that comparisons remain meaningful.

BENEFITS

Navy leadership has called for technologies that support analytics of big data sets such as avionics and human performance; however, as new systems or technologies are introduced and/or new tactics emerge to maintain superiority, underlying data sources may change. At this time, systems are built to support basic trends and statistical outputs, without accounting for this shift. Given the implications of decision makers relying on outputs to adapt training, modify resources or refine tactical approaches, a solution for understanding the implications or adjusting results based on these types of shifts is required. Advance statistical or novel modeling techniques are sought to address this unique challenge.

STATUS

This STTR has completed Phase I efforts by three vendors. After an extensive review of Phase I work by the three contractors, one was invited to propose a full Phase II. The award of Phase I option efforts has been completed, and Phase II contract award is in progress.

MILESTONES

- Phase I:
  - Kickoff meetings were held with each of the three Phase I contractors
  - Contractors status was monitored via bi-monthly progress reports and periodic status updates
  - Closeout briefs were held with each of the contractors to discuss Phase I progress and Phase II plans
  - Phase I Option was awarded for single vendor
- Phase II:
  - One contractor was invited to submit a Phase II proposal
  - Phase II contract award is in progress

TRANSITION OF CREW ROLE-PLAYER ENABLED BY AUTOMATED TECHNOLOGIES TO MARITIME PATROL TRAINING

OBJECTIVE

This effort will conduct the research and development necessary to refine the Crew Role-player Enabled by Automated Technology Enhancements (CREATE) technology to facilitate transition to PMA-205 and PMA-290, focusing on conducting human factors analyses, feasibility of automated performance measures for communication, and performance testing.

Aircrewmen assigned to Patrol Squadron (VP) 8 perform pre-flight procedures aboard a Boeing P-8A Poseidon maritime aircraft in preparation to support search and rescue efforts for the missing Republic of Korea cargo ship crew in the FOURTH Fleet Area of Operations

PROJECT DURATION

OCT 2017 - SEP 2020

FUNDING SPONSOR

Naval Air Systems Command (NAVAIR) | Section 219

POINTS OF CONTACT

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DESCRIPTION

The CREATE technology development has progressed significantly over the last two years, resulting in increased interest in harnessing the technology by platforms. However, work to date has focused on the challenges associated with the integration of speech and behavior modeling technologies. As platforms move forward with activities to implement this technology, greater attention is necessary to refine the instructional interface to ensure that an appropriate amount of data is provided that will facilitate human-machine trust without placing additional unnecessary workload on operators.

NEED

The successful transition of autonomous crewmembers technology seeks to solve a long-standing training challenge - how to train a single trainee in a task that requires a crew or group to execute it. Through a software solution for autonomous crewmembers that builds on recent technological advances in speech recognition, this technology transition effort has the potential to reduce operator workload and facilitate more robust and realistic training of skills such as crew coordination earlier in the training pipeline.

BENEFITS

SBIR work has focused on the challenges associated with the integration of speech and behavior modeling technologies. As platforms move forward with activities to implement this technology, greater attention is necessary to refine the instructional interface with the appropriate amount of data to facilitate training without placing additional unnecessary workload on operators. The lack of attention to these factors now, ahead of transitions, will result in schedule and financial impacts to programs to address usability issues identified after fielding. Additionally, increased usability at the on-set will increase fleet buy-in and increase the likelihood of successful fielding.

STATUS

Efforts in FY18 focused on human factors analyses, research opportunities for advanced performance assessment through communication capabilities, and fleet testing of the component capabilities and integrated system performance. Also during FY18, interface mockups were developed for usability decisions. FY19 will consist of IRB approval, data collection from the P8 community , data analyses, and reporting.

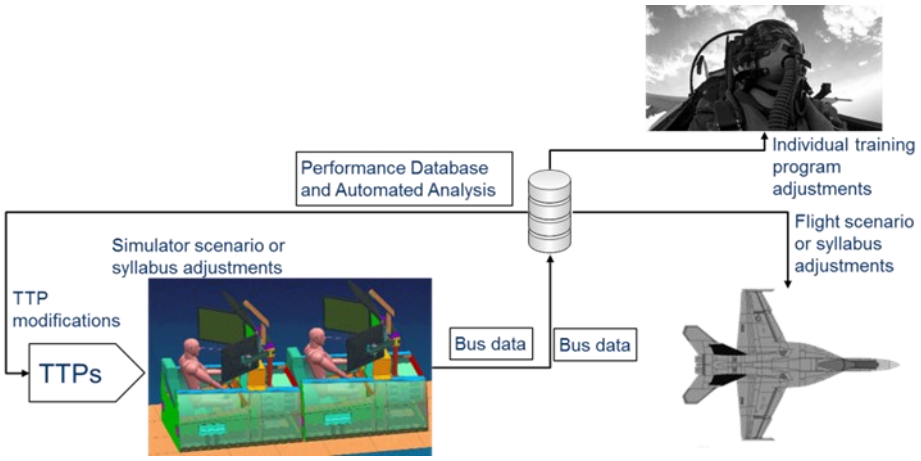
MILESTONES

- Manuscripts/Publications: Anania, E. C., Killilea, J., & Atkinson, B. F. W. (2018). *The application of automation systems for training - Implications of trust*. Proceedings of the Interservice/Industry Training Simulation & Education Conference, Orlando, FL.
- Presentations:
  - G. Severe-Valsaint, (2018, March 12). Information Exchange / Observing PTT Training. NAWCTSD, ASEC, P-8 Fleet.
  - J. Killilea, (2018, May 03). P-8 Technical Interchange Meeting. P-8 NAWCTSD IPT, Soar Tech, P-8 Jacksonville CPRW-11.
- Workforce Development: Purchased research equipment to facilitate detailed system interface analysis and workload impacts via eye tracking technology.

OFFICE OF NAVAL RESEARCH TECHNOLOGY CANDIDATE: NOTORIOUS

OBJECTIVE

Develop the underlying architecture for the Naval Air Warfare Development Center's Integrated Training Facility's (ITF's) data collection/debriefing toolset.



Developing LVC multiteam performance measures

PROJECT DURATION

DEC 2017 - OCT 2019

FUNDING SPONSOR

Office of Naval Research (ONR);
Naval Aviation Training Systems Program Office (Program Management Activity [PMA] 205)

POINTS OF CONTACT

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DESCRIPTION

The science and technology of this Technology Candidate will focus on developing an assessment architecture that will automatically and adaptively collect, fuse, display, analyze, and archive training data (Live, Virtual, Constructive) from disparate systems. Competency-based, automated objective performance measures will be developed at the individual, unit, and carrier strike group level. These measures will be used for debrief and trend analysis to support decision making (currency, proficiency, acquisitions). Additionally, these measures will be enable comparison between live, virtual, and constructive (compare differential impact of simulation and live training opportunities). These data will be stored in a centralized system that will enable rapid development of post-mission and readiness reports.

NEED

Performance assessment of Carrier Airwings (CVWs) during integrated training relies solely on qualitative instructor assessments presenting resource challenges with manpower, training time for instructors, standardization of metrics and feedback, and overall accuracy of recorded data. This practice requires instructors to pull data from multiple, disparate, often stove-piped systems and manually synthesize these data to conduct debrief and provide assessments which is time intensive.

BENEFITS

This capability will provide instructors with relevant data that is automatically fused to allow for increased for a reduction in manpower and time requirements for instructors. This will also reduce instructor workload focused on assessment and allow for increased quality of instruction and ultimately greater warfighter proficiency and readiness. Finally, this tool will allow for comparison between simulator and flight performance, assess the effect of simulator rehearsal on live flight proficiency, and enable development Concept of Operations and refinement of Tactics, Techniques, and Procedures (TTPs).

STATUS

This effort kicked off in FY18 and is currently in the process of identifying existing measures, gaps for further development, and baselining automation based on current manual practices.

MILESTONES

- Framework for categorizing existing performance measures developed; identification of existing measures and gaps for further development underway
- Feasibility analysis of Proficiency-enabled NGTS completed
- Observations of Integrated Air Defense Course (Fallon) and Airwing Fallon conducted to understand baseline for existing metrics and practices

INVESTIGATION OF TRAINING FIDELITY FOR CARRIER QUALIFICATION AND PRECISION LANDING MODES

OBJECTIVE

This effort will research the level of flight simulation fidelity required for the carrier landing training using Precision Landing Mode (PLM) flight control laws. Deliverables include 1) data analytics reports that identify training gaps and performance issues for both pilots and LSOs, 2) simulated and live data that will be leveraged for the LSO virtual reality (VR) trainer and computational pilot models, and 3) empirical reports documenting solutions for training gaps and performance issues.

Landing Signal Officers (LSOs)

PROJECT DURATION

OCT 2017 - SEP 2020

FUNDING SPONSOR

Naval Air Systems Command (NAVAIR) | Section 219

POINTS OF CONTACT

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DESCRIPTION

Precision Landing Mode (PLM) refers to a set of control laws that adds additional landing modes designed to improve pilot landing and recovery capabilities. These control laws decrease workload for pilots and improve aspects of recovery and landing performance (e.g., centralized landing patterns). However, the reaction of the aircraft to inputs from the pilot is different and the techniques of Landing Signal Officers (LSOs) waving pilots land at the ship may need to change. This will necessitate adjustments to pilot skills sets, disrupting long automated muscle memory and decision making for expert pilots and introduce more complex learning for novice pilots due to additional modes.

NEED

Originally planned for initial roll out early in FY18, integration started over a year early (Q4FY16) and is estimated to be fully integrated by the end of FY17. This early delivery of the PLM upgrade technology may result in pilots being undertrained as they struggle with either learning techniques for multiple modes or unlearning long held habits and muscle memory reactions under quick timelines and dangerous conditions (experts). This can present its own set of challenges such as negative impacts on muscle memory maintenance and mode confusion.

BENEFITS

First, the relationship between simulation fidelity and transfer/ learning area is generating significant attention in the Navy as we shift toward less live flight training and more simulation-based training, to save cost and increase safety. Thus, a need exists within the Navy to empirically evaluate theories of training transfer and fidelity in the environment when new technology is introduced and Fleet requirements change. Furthermore, this effort will provide a significant contribution to the scientific community in that it will provide an understanding of the relationship between fidelity and learning in highly complex, dynamic military environments.

STATUS

Project kick off in October 2017 and plans are being made to coordinate with other partner agencies. First major data collection is scheduled for Jan 2018.

MILESTONES

- Planning and development of experimental protocol and timeline.
- Analyze fleet data.
- Update low and high fidelity simulators.

NAVAL INTEGRATED FIRE CONTROL – COUNTER AIR (NIFC-CA X)

OBJECTIVE

This effort fills a critical training gap in the NIFC-CA community by leveraging existing investments from the Live, Virtual, and Constructive (LVC) Training Fidelity Enabling Capability. Specifically, ONR funded an AIR 4.6.5-led effort coordinated with 5.4 focusing on the development of a mission visualization capability that can be used to train cross-platform coordination associated with NIFC-CA employment utilizing the core LVC technologies.

PROJECT DURATION

MAR 2014 - OCT 2018

FUNDING SPONSOR

Office of Naval Research (ONR)

POINTS OF CONTACT

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DESCRIPTION

Initial proof-of-concept capability developed in FY14 was a collaboration between NAWCAD/TSD and government contractors. Phase 1 delivered a classroom-based tool utilizing a streamlined version of the NGTS's Battle Monitor to provide a "gods-eye view" map of a scripted NIFC-CA scenario. This enabled trainees to make decisions regarding how to counter a small number of threats, provided after action review and feedback. Phase II and II.5 have expanded content and feedback for Tactical Training Group Atlantic/Pacific (TTGL/P), and E-2D Fleet Readiness Squadron (FRS).

NEED

As integrated warfare capabilities like NIFC-CA become increasingly important to Navy's Carrier Strike Groups, the requirement for Virtual and Constructive training environments becomes increasingly necessary in order to provide true systems-of-systems and multi-team training. Currently, the integrated commands are significantly limited in the training they can provide and most of that is only done live based on LVC limitations training.

BENEFITS

This capability provides the Fleet with a mission visualization tool for classroom based training allowing for visualization during the scenario, collaborative decision making, and feedback on performance to enable readiness and cross platform coordination. Additionally, the high fidelity, physics-based models developed for NIFC-CA X are resident in the NGTS and therefore can also support simulation-based training for NIFC-CA.

STATUS

The tool has been enhanced under funding from the Small Business Innovative Research program to support a more flexible architecture including: the ability to manipulate the blue force laydown, scale threats to meet training objectives, and flexible performance assessment architecture. These capabilities are being delivered to the E-2D Fleet Replacement Squadron (FRS) to support training their Air Defense syllabus. Additionally, the tool was delivered to Harry S. Truman (HST) Strike Group for further evaluation.

MILESTONES

- Receipt of the 16th Annual Naval Air Warfare Center Aircraft Division Commander's Award
- Phase 2 capability delivered and demonstrated to TTGP (JUL 2017)
- HST Strike Group utilized NIFC-CA X during AD Syndicate (JUL 2017)
- Delivered to 4 systems to HST Strike Group (APR 2018)
- Delivered beta version of SBIR capability to E-2D FRS to support “train the trainer” (NOV 2018)
- Delivering final SBIR capability to E-2D FRS for use in Air Defense syllabus JAN 2019

SQUAD OVERMATCH/ TEAM OVERMATCH: SITUATION AWARENESS, TEAM DIMENSIONAL (TDT) AND RESILIENCE TRAINING FOR TEAMS

OBJECTIVE

1) Accelerate the development of high performing teams through integrating team decision making skills with tactical training, 2) Develop readiness, resilience, and lethality, and 3) Train teams to learn *what* information to pass *when* and *how* to develop a common operational picture to support both tactical and medical decision making

Soldiers conduct a SOvM exercise to practice situation awareness skills, resilience skills, team dimensional performance skills, and tactical combat casualty care at Camp Buehring, Kuwait.

PROJECT DURATION\

JAN 2015 - SEP 2020

FUNDING SPONSOR

Defense Health Agency (DHA)

POINTS OF CONTACT

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DESCRIPTION

SOvM developed team resilience strategies that focus on the recognition of self/buddy cues that illustrate acute stress reactions and teaches 'tactical resilience care' behaviors to provide on the spot stress injury care. This was integrated into the SOvM Train the Trainer (T3) software package that provides comprehensive planning and execution support for conducting a platoon level exercise with integrated cognitive skill strategies, practice scenarios, and curriculum.

NEED

There is a need for Resilience training for Joint forces that optimizes performance, and mitigates the effects of stressors encountered on tactical performance.

BENEFITS

In a short (5 day) integrated curriculum, soldiers and Marines receive training that provides improvements in individual and team performance for tactical and process skills (i.e., tactical combat casualty care, team dimensional training performance, situation awareness, and resilience).

STATUS

Operational Implementation throughout USARPAC:

U.S. Army Central Command (USARCENT); 3rd/1st Armor Brigade Combat Team, Camp Buehring, Kuwait

U.S. Army Pacific Command (USARPAC); 25th Infantry Division, Camp Casey, Korea

II Marine Expeditionary Force (IIMEF); 2nd Marine Division (2MARDIV), Camp Lejeune, NC

U.S. Army Pacific Command (USARPAC); 25th Infantry Division, Schofield Barracks, HI

MILESTONES

- Updated SOvM Train-the-Trainer (T3) / Training Support Package (TSP), enabling platoons to plan and execute an exercise that fully integrates individual and team cognitive skill sets to supplement tactical performance.
- Developed a Team Resilience Practical Application that provides perceptual recognition training and interactive performance opportunities
- Developed a TC3 manikin operation class
- Developed a Team Resilience Virtual Application Practice that provides immersive scenarios that allow interactive training on recognition of ASR, procedural knowledge, and execution practice

ACCELERATING THE DEVELOPMENT OF SMALL UNIT DECISION MAKING (ADSUDM)

OBJECTIVE

The purpose of this effort is to enhance USMC simulation-based Small-Unit Decision Making (SUDM) training through multiple integrated software components: 1) Decision Making-Learning Management System (DM-LMS) for tracking trainee performance over time and providing After Action Review, 2) Digital Integrated Representation of Tactical Environment (DIRTE) tools for simulation terrain database generation, and 3) Simulation Tailored Training and Assessment (ST2A) that provides adaptive training for computer-based decision-making training.

Left: Spartan After Action Review (SPAAR) tool (part of DM-LMS).
Right: The Adaptive Perceptual Cognitive Training System (APACTS) (ST2A)

PROJECT DURATION

JUL 2016 - DEC 2018

FUNDING SPONSOR

Office of Naval Research (ONR)

POINTS OF CONTACT

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DESCRIPTION

ADSUDM features 3 interoperable software components that collectively form the overall Decision-Making (DM) training capability. Central to the architecture is a relational database that provides a persistent store of Marine performance data that can be accessed and annotated to support streamlined After Action Review (AAR), personalized curriculum delivery, and performance analytics data for unit leaders. ADSUDM also includes an adaptive trainer that monitors student performance and provides embedded tutoring and scenario adaptation focused on terrain reasoning skills. Lastly, ADSUDM integrates software tools for instructors to rapidly generate relevant real-world terrains to support DM training.

NEED

1) Expeditionary Force 21
2) 37th Commandant of the Marine Corps FRAGO 01/2016 and the USMC 36th Commandant's Planning Guidance 2015
3) SITE Initial Capabilities Document (ICD) (Gap 8 & 11) [NOTE: SITE is now ITRS]
4) FNC Gap 15-44: Training Time and Cost Reduction Technologies (e.g., ICD, CDD, etc.)
5) FNC Gap 16-46: Small Unit Decision Making Training Technologies
6) FNC Gap 16-45: Optimized Mixed Training Environments for Operations
7) DVTE CDD - system deficiency identified: After Action Review
8) USMC Force Development Strategic Plan 2015.

BENEFITS

The ADSUDM effort will improve small unit performance and DM skills, save the Marine Corps both time and cost to train, provide additional reps and sets for decision-making training, decrease the time required to develop squad leaders, and provide AAR capabilities after training event completion for both live and virtual training events.

STATUS

Demonstrations of the ADSUDM technologies have been given at various events and to many stakeholders, including: School of Infantry (SOI)-East, 2nd Battalions/6th Marines, Infantry Officer Course, Program Manager Training Systems (PM TRASYS), Training and Education Command (TECOM), and the Assistant Commandant of the Marine Corps. In 2017, Tactical Decision Kits (TDKs) with ADSUDM software were deployed by the USMC Rapid Capabilities Office (RCO) to all 24 USMC Infantry battalions. Based on feedback from the TDK deployment (and mini-systems provided to schoolhouses), a TDK 2.0 release is planned for the end of 2018. ADSUDM is in its final year of execution as a Capable Manpower Pillar Future Naval Capability and is transitioning to PM TRASYS in early 2019.

MILESTONES

- Yearly update to the Technology Transition Agreements (TTA) for ST2A, DIRTE, and DM-LMS
- Demonstrations: IITSEC 2017 & 2018, Modern Day Marine 2017 & 2018, Naval Future Force S&T Expo 2017, and to various USMC battalions, school houses, the Assistant Commandant of the Marine Corps, and to various other stakeholders including TECOM and PM TRASYS.
- Transition: The Rapid Capabilities Office (RCO) of the USMC transitioned initial versions of the ADSUDM software and hardware to the Tactical Decision Kits (TDKs) that were delivered to all battalions in the Marine Corps (24) in 2017.
- Data Collection and testing events with Marine Corps battalion: Spartan Tactical Games I, II, III, and IV.
- TDK software version 2.0 will be transitioned to the Marine Corps in early 2019.

AUGMENTED TRAINING FOR EXPERIENTIAL LEARNING FOR LANDING SIGNAL OFFICERS

OBJECTIVE

In an effort to mitigate the predicted impact of training optimization on the LSO training pipeline, we are working to 1) identify training challenges for LSOs in reaction to Navy training optimization, 2) identify and develop technologies to supplement live training opportunities for LSOs (and 3) develop and validate methods for implementing this technology within the LSO curriculum that can supplement LSO training issues resulting from reduced live training.

Products

- *LSO Pre-training*
- *Planned Publications*
- *Analysis findings to be presented at HFETAG (2018)*
- *Experiment 1 findings to presented at HFES (2018) or AHFE (2018)*

Transition

- *Potential transition of instructional capabilities to LSO Trainer (existing) and CBT for use at LSO School at Oceana for Course pre-training*

Workforce Benefits

- *Mentoring Opportunities*
- *Naval Research Enterprise Internship Program (NREIP) Intern (Engineering and Psychology): A. Neigel*
- *Incoming NREIP Intern (Engineering and Psychology): Summer FY17*

PROJECT DURATION

OCT 2015 - SEP 2018

FUNDING SPONSOR

Naval Air Systems Command (NAVAIR) | Section 219

POINTS OF CONTACT

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DESCRIPTION

The objective of the Maritime Augmented Guidance with Integrated Controls for Carrier Approach and Recovery Precision Enabling Technologies (MAGIC CARPET) project is to provide the pilot with a control concept that is so easy to fly aboard the ship that minimizes initial training, proficiency and currency requirements. The science and technology includes control concepts that rely only on onboard sensor/control capability.

NEED

On the job training accounts for majority of LSOs training (i.e., Field Carrier Landing Practice, and the Carrier Qualifications). However, with improvements to carrier landing technology on some aircraft (e.g., MAGIC CARPET) and the push to optimize training and reduce costs, combined with current deployment schedules, reduction to CQ, FCLP, and time on the platform has left a training gap for live LSO training opportunities. Reductions in budget have also left gaps and deficiencies in the LSO operational trainer.

BENEFITS

Landing Signal Officers (LSOs) have a unique and important role in US Naval Aviation. Specific to ship board landings, LSOs are tasked with the "safe and expeditious recovery" of naval aircraft aboard aircraft carriers and are required to assess, coach, correct, and mentor pilots landing at the ship (LSO NATOPS Manual). LSOs currently still require up to 1000 live landings to accurately calibrate their visual perception of aircraft deviations. Their ability to maintain these numbers in the face of reduced live flights for CQ in general will be a challenge. The introduction of supplemental training that can enhance this calibration could address some of these challenges and is essential in moving forward with optimized training.

STATUS

Empirical training effectiveness study was delayed due to pilot availability but will be conducted in FY18 in conjunction with simulation based training upgrades (e.g., interactive recreations of seminal incidents as training content in simulator). Content, sample populations, and additional technologies have been identified. Development of simulation based content and improvements to content in LPT CBT are ongoing.

MILESTONES

- Developed LSO Pre-Training (LPT) Computer Based Training Application
- Completed technology review for VR
- Developed experimental plan
- Developed Performance and Training objective matrix
- Briefed LSO Training applications and research at LSO OAG
- Collected data on USS Dwight D Eisenhower (CVN69) during SUSTEX
- Priest, H., McNamara, C., Grubb, J., (2017, February 21). "*Virtual/Augmented Reality in Naval Aviation Training: A Window into the Future.*" WEST 2017-San Diego.
- Final Report from Training Analysis for LSO School Simulation based training.
- Measures for LSO Simulation Based Training.

DISTRIBUTED VIRTUAL REALITY TESTBED

OBJECTIVE

The objective of this effort is to develop a distributed, multi-user virtual reality (VR) test bed. The test bed will enable virtual cooperative team training in which two or more students, who are in the same or different geographical locations, to execute team training tasks together in a virtual world.

LCDR Ryan Kramer explores a simulated Virginia class submarine in the VR prototype for the Virtual Interactive Shipboard Instructional Tour® (VISIT®)

PROJECT DURATION

OCT 2017 - SEP 2019

FUNDING SPONSOR

Naval Air Systems Command (NAVAIR) | Section 219

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DESCRIPTION

Our technical approach is to leverage our existing single participant VR assets (e.g., HTC VIVE, Oculus Rift, 3D models, Unity scripts) and our technical experience to develop a framework for rapid, distributed, multi-user VR training prototype development. Our approach will also provide a cross-platform (e.g., Linux, Windows, macOS) distributed VR environment that will act as a template for future VR research, experimentation, and prototype development.

NEED

In many existing team training and collaborative environments, each individual is physically collocated (e.g., pilot/copilot, navigation bridge crew, maintenance team) in order to utilize physical equipment (e.g., cockpits, navigation equipment, gear being maintained). By placing virtual instances of the equipment in a shared virtual environment, it becomes possible for team collaboration without requiring geographic collocation.

BENEFITS

The proposed effort has multiple benefits for NAWCTSD. To perform this task, the workforce must learn the best methods for networking multiple VR devices together seamlessly. The team members must also gain experience using realistic avatars so that each participant can effectively interact with the other participants in the virtual world to accomplish team training tasks. These improved skills will result in a more capable workforce that will be better prepared to employ emerging VR technologies solve future training problems. The software libraries and packages developed as part of this effort can be reused and will allow the lab to leverage the experience to solve other problems in the domain of team tasks in networked VR.

STATUS

The FY19 Execution Plan is as follows:

1. Develop voice over IP (VOIP) solution for communication .
2. Package all scripts and libraries into framework .
3. Apply framework to practical domains (MEPP, Rig for dive) .
4. Usability testing / documentation.
5. Document framework

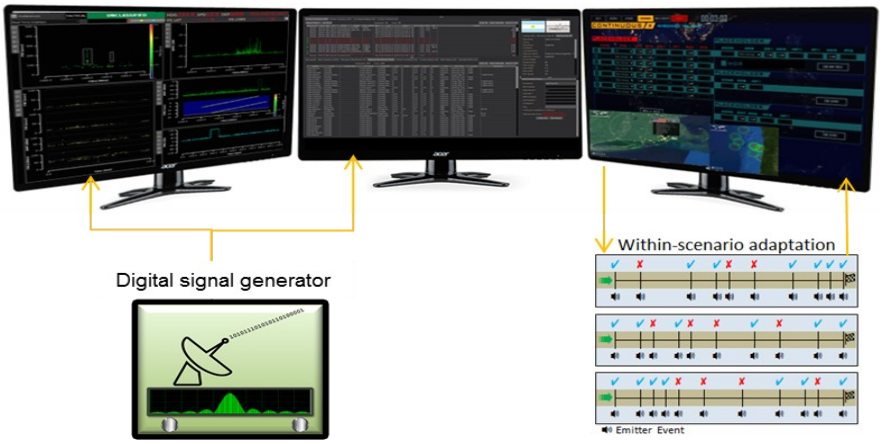
MILESTONES

- Package the software components (scripts and libraries) into developer tools
- Conduct usability testing and document developed software components

ELECTRONIC WARFARE—MICRO ADAPTIVE TRAINING (EW-MAT)

OBJECTIVE

The main objectives of this Future Naval Capability (FNC) are to (1) create validated micro-adaptive training algorithms to diagnose the strengths and weakness of operators in real time as they perform actions using the on-board tactical system, (2) develop a digital signal generator that will inject realistic signals in an on-board trainer, (3) evolve the state-of-the-art in EW hardware and software to create a common EW framework for air, sea, and undersea platforms.



PROJECT DURATION

SEP 2017 - DEC 2022

FUNDING SPONSOR

Office of Naval Research (ONR)

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DESCRIPTION

The research team will develop a training architecture within ONR's Rough Squid EW Sandbox that allows operators to perform actions using the on-board tactical system hardware/software. The architecture will support a digital signal simulator to inject realistic and robust signals representative of advanced EW sensors along with micro-adaptive training algorithms to diagnose the strengths and weaknesses of operators in real time during training.

NEED

Submarine EW operators provide critical, time-sensitive information for maintaining ship safety and avoiding counter-detection. Yet there is no current capability for embedded, on-board adaptive training for Electronic Warfare (EW) operators. As described by the Submarine Force Electronic Warfare Wholeness Campaign, training is needed which can "rapidly improve experience level of current EW operators." Furthermore, the Submarine Tactical Requirements Group (STRG) recently has recommended Adaptive Training (AT) to fulfill critical training gaps (requirement STRG-TRG-.0(1)).

BENEFITS

Research has demonstrated that AT systems lead to improved performance while requiring less training time. These outcomes provide the potential to enhance training for submariners by improving the Navy's ability to provide tailored, individualized instruction to operators, and therefore enhancing readiness, without increasing the Submarine Force's overall training costs, time, or number of instructors. Additionally, investing in a cross-platform training solutions (e.g., the digital signal generator), will lead to more highly trained operators in the Fleet capable of managing increasingly complex RF environments. Thus allowing the Navy to maintain its maritime superiority and decisive edge.

STATUS

This FNC was provided jump-start funding in FY18 with the major tasking to begin in FY19. The first major development thrust will involve expanding upon the adaptive training service modules, scenarios, network interfaces, and user interfaces that were developed in the Submarine EW Adaptive Trainer (SEW-AT) effort and incorporating them natively into Rough Squid. Additionally, we will tackle several S&T challenges including the appropriate design of adaptive training (in terms of instructional content and adaptive scheduling) and its performance impact/training value.

MILESTONES

- Provided several demonstrations of initial SEW-AT integration with ONR's Rough Squid EW Sandbox system to Fleet representatives, resource sponsors, and transition customers including CAPT Brad Neff (OPNAV N97), CAPT Rhett Jaehn (OIC UWDC Norfolk, Submarine EW Wholeness Lead), Mr. Don Gerry (Director of Submarine Safety, COMSUBPAC), Mr. Phil Faye (OPNAV N2/N6), Mr. Dave Wheeler (PMA-290), Dr. Wen Masters, SES (ONR), and Dr. Michael Pollock, SES (ONR).
- Re-hosted the SEW-AT GUI and Adaptive Training Service and converted existing SEW-AT scenarios (from analog to digital) to be compatible with Rough Squid architecture.
- Marraffino, M. D., Schroeder, B.L., Fraulini, N. W., Johnson, C. I., Van Buskirk, W.L. (2018). Effects of difficulty adaptation schedules on trainee performance. Presented to the *20th Congress of the International Ergonomics Association*.
- Schroeder, B. L., Fraulini, N. W., Marraffino, M. D., Landsberg, C. R., Van Buskirk, W. L., & Johnson, C. I. (2018). Exploring techniques for individualized training: Interacting effects of difficulty adaptation and personality. Presented to the *20th Congress of the International Ergonomics Association*.

ELECTRONIC WARFARE (EW) TACTICAL DECISION AID (TACAID)

OBJECTIVE

The technical objective of the EW TACAID project is to develop an adaptive training (AT) capability that will improve warfighter ability to manage an increasingly complex radio frequency (RF) environment while maintaining safety of ship. The goal is for the system to diagnose issues that the trainee is having in real-time, provide targeted feedback to correct those issues, and adjust the difficulty of the training if necessary.

Submarine Electronic Warfare—Adaptive Trainer (SEW-AT)

PROJECT DURATION

OCT 2015–SEP 2018

FUNDING SPONSOR

Office of Naval Research (ONR)

POINTS OF CONTACT

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DESCRIPTION

TACAID is developing and integrating AT approaches into on-board submarine systems. The Submarine EW Adaptive Trainer (SEW-AT) algorithms will diagnose the strengths and weaknesses of students in real-time as they perform actions during training, which are used to provide tailored instruction for each trainee. These algorithms include adaptations to the feedback based on trainee performance, as well as modifications to training difficulty. EW TACAID will provide two products: (1) matured AT software modules ready for incorporation into submarine tactical systems; and (2) shore based and portable standalone training system prototypes delivered to the fleet for training to support EW Wholeness campaign.

NEED

The EW Wholeness Campaign has identified a critical training gap in EW which is being partially fulfilled by SEW-AT. With the increasing complexity of the EW environment, there is a need to provide operators with more effective and efficient training. AT has been shown to be effective in the literature; however, studies have mostly focused on simple tasks. Although some researchers have investigated more complex military environments, additional evidence would further support the use of AT for complex military tasks.

BENEFITS

Because the EW task is particularly challenging and dynamic, research that emerges from this program will expand the empirical base for the AT domain and open doors for its use in more complex tasks. The current state of the art with AT is based on simpler tasks, but this project will inform sophisticated algorithm development for real-world, complex tasks. Early data with submariners show performance improvement (increased accuracy and timeliness of reports) after using SEW-AT. The adaptive algorithms developed through this project will improve upon current training capabilities, as research shows that AT enhances learning gains and performance compared to traditional training.

STATUS

We continued development of SEW-AT which includes refining adaptive algorithms and increasing the scenario library (currently have 150 dynamic scenarios and related course content reviewed by COMSUBPAC). We collected, analyzed, and reported out on 7-10 months of SEW-AT usage data from 6 Submarine Learning Center (SLC) Detachments. Data from these sites showed ~60% improvement in accuracy as well as large reductions in late and missed calls with long-term use. Additionally, we provided system refreshes with new content and software updates this FY. We are also working on the RMF process in order to obtain an Authority To Operate (ATO) .

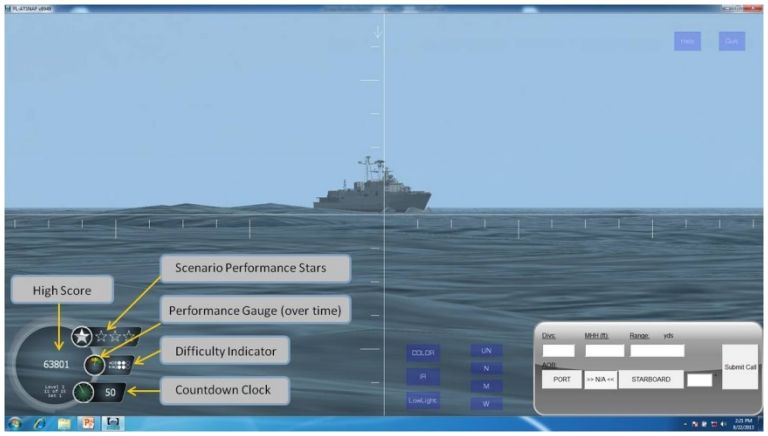
MILESTONES

- Delivered prototype lunch box (standalone) systems to 4 deploying submarines for use on-board.
- Delivered prototype SEW-AT systems to 6 Submarine Learning Center Detachments.
- SEW-AT has been embedded in the submarine EW Wholeness Campaign Plan as a critical training element.
- Provided numerous demonstrations of SEW-AT integration with NUWC's EW Sandbox system to Fleet representatives, resource sponsors, and transition customers including CAPT Brad Neff (OPNAV N97), CAPT Rhett Jaehn (OIC UWDC Norfolk, Submarine EW Wholeness Lead), Mr. Don Gerry (Director of Submarine Safety, COMSUBPAC), Mr. Phil Faye (OPNAV N2/N6), Mr. Dave Wheeler (PMA-290), Mr. Scott Hastings (PMS-435), Mr. Sean Watterson (Chief Engineer, PMS-435), ETRC Roberts (EW Rate Lead, SLC), Mr. Joe Baldi (Director of Training, SLC), and ETRCS Ensley (UWDC TAG).
- 7 publications and presentations (available upon request).

EXAMINING THE EFFECTS OF GAME FEATURES ON LEARNING IN SCENARIO-BASED TRAINING

OBJECTIVE

The objective of this research is to systematically test the impact of two game features on performance and motivation: score/performance gauges and competition. To date, there is no previous research that suggests adding game gauges increases motivation or enhances performance, and likewise, little research has examined the effect of competition on learner performance and motivation in game-based training.



The Periscope Operator Adaptive Trainer (POAT) user interface with game gauges included (bottom left).

PROJECT DURATION

OCT 2015 - SEP 2018

FUNDING SPONSOR

Naval Air Systems Command (NAVAIR) | Section 219

POINTS OF CONTACT

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DESCRIPTION

Previous research has shown mixed results on the efficacy of game features to promote learning outcomes and motivation, and the majority of these studies have not systematically investigated game features to determine which ones are most effective. Based on Cognitive Load Theory, we hypothesized that adding both competition and game features would increase motivation and enhance performance in a simulation-based training task. In a set of experiments, we explored whether the presence of game features (performance gauges and score) and competition features (a leaderboard) affected motivation and learning outcomes within the Periscope Operator Adaptive Trainer (POAT).

NEED

In light of budget declines, there has been a strong push across the DoD for low-cost training techniques that are engaging, realistic, and can be delivered anytime, anywhere. Game-based training techniques hold promise to meet this demand as they are purported to enhance player motivation. However, existing research on the effectiveness of game-based training is mixed and often nonsystematic, resulting in a failure to identify specific game features that lead to better learning and performance outcomes.

BENEFITS

Game-based training may be well-suited to meet the Navy's education objectives, given the popularity of computer games with today's young adults. This research seeks to examine the effects of incorporating game features into simulation-based training, a topic that has not been systematically investigated in the training literature. Previous studies have assessed the value of game-based training over traditional methods of instruction, but few have investigated individual game features and their impact on performance and motivation. The findings of these experiments may have a broad impact on future training systems by offering empirically-based guidance for designing game features to enhance effectiveness.

STATUS

In FY18, the research team conducted two experiments. Experiment 1 was conducted with approximately 120 college students, and the results showed that incorporating game features into training did not improve trainee performance on the task or their motivation to play the game. Experiment 2 was conducted with approximately 70 submarine officer students at NAVSUBASE New London, utilizing a simpler experimental design. Experiment 2 replicated the results of Experiment 1.

MILESTONES

- Completed data collections for Experiment 1 with a college student population and Experiment 2 with Submarine Officer Basic Course (SOBC) students.
- Developed experimental testbed for systematically evaluating game features, such as scores, leaderboards, and performance gauges in the Periscope Operator Adaptive Trainer (POAT).
- Presentation: Mercado, A. D., Johnson, C. I., Landsberg, C. R., & Bailey, S. K. T. (2018, August). A systematic evaluation of game features in simulation-based training. Poster presented at the International Ergonomic Association conference.
  - ◊ Analyzed data and wrote report of results from SOBC experiment, concluding that game features do not increase motivation nor improve the accuracy of periscope calls. Adaptive training increased call accuracy regardless of inclusion of game features.

INVESTIGATING LOW-COST UNTETHERED VIRTUAL REALITY TECHNOLOGIES AND THE ROLE OF AFFORDANCES ON TRAINING EFFECTIVENESS IN AN IMMERSIVE ENVIRONMENT

OBJECTIVE

1. Investigate and evaluate the feasibility and limitations of emerging, low cost, COTS, 3D VR-based technologies for training systems.
2. Examine whether some of the affordances of an immersive VR environment enhance performance.
3. Investigate safety and alignment issues associated with mixed reality.

User in Prototype Testbed using Virtual Reality (VR) Headset

PROJECT DURATION

OCT 2014–SEP 2018

FUNDING SPONSOR

Defense Health Agency (DHA) | Joint Program Committee (JPC)-1

POINTS OF CONTACT

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DESCRIPTION

- Investigated and evaluated the feasibility and limitations of emerging, low cost commercial-off-the-shelf (COTS) 3D immersive technologies (e.g., virtual reality [VR] head-mounted displays [HMDs], camera-based tracking, and low cost game engines) to provide practical and effective virtual reality information delivery within a training and/or performance aiding context.
- Built testbed using existing E-28 maintenance software in conjunction with Oculus Rift VR HMD and Microsoft Kinect cameras.
- Conducted Experiment #1, investigating gesture affordances.
- Built testbed using HTC Vive VR HMD. Designed and executing Experiment #2 on mixed reality and feedback.

NEED

VR training solutions have the potential to reduce training cost, maximize training impact, and maximize transfer of knowledge from the classroom to the operational environment. The exploration of low cost VR alternative technologies will help to inform designs and uses of VR technologies that may lead to adding VR to areas previously limited by program budgets. This work will help the NAE remain at the front of applied S&T understanding on how best to make use of the technology.

BENEFITS

Expand the research on best practices for improving learning in VR. Experiment 1 examines: a) whether VR is more effective for training procedures than desktop-based training, and b) different methods interacting within VR (gesture-based vs. voice-based interactions). Experiment 2 explores different methods of providing feedback in VR.

STATUS

The project is entering its final year. The second experiment is underway. The results will be collected, analyzed, and reported by the end of FY18.

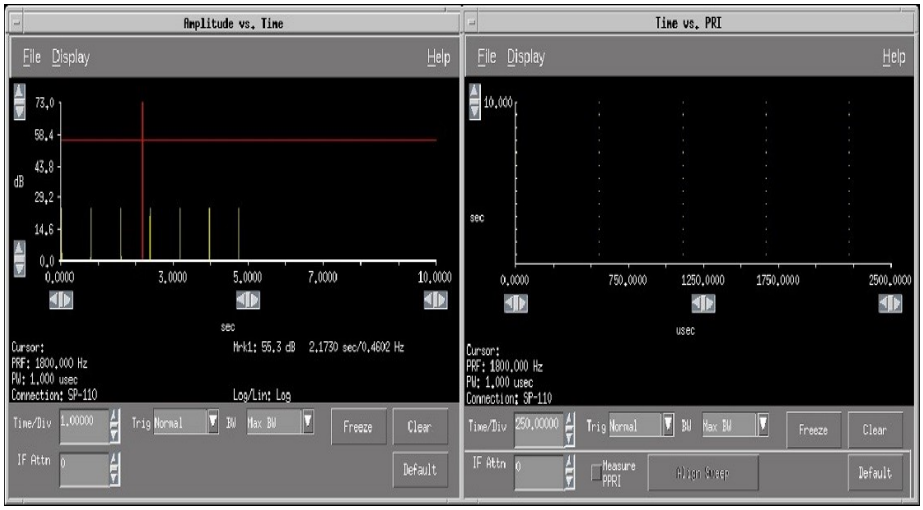
MILESTONES

- Experiment 1 wrap-up: Present research at Psychonomics and I/ITSEC conferences
- Complete Experiment 2
  - Complete data collection
  - Analyze data
  - Write up results for conference submission to the Human-Computer Interaction International Conference (HCII)
- Planned submission of journal manuscript to *Journal of Experimental Psychology: Applied*
- Planned paper on Experiment 2 results, HCII proceedings

INVESTIGATION OF MICRO-ADAPTATION SCHEDULES TO SUPPORT ELECTRONIC SUPPORT MEASURES OPERATOR ADAPTIVE TRAINING

OBJECTIVE

This project aims to compare different difficulty adaptation schedules within an Adaptive Training (AT) system in an effort to determine the most efficient and effective way to employ AT algorithms within a submarine Electronic Support Measures Domain.



Simulated Real-time Displays

PROJECT DURATION

DEC 2016 - DEC 2018

FUNDING SPONSOR

Office of Naval Research (ONR)

POINTS OF CONTACT

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DESCRIPTION

Previous research has shown that including Adaptive Training (AT) techniques to a domain trainer is more effective than its non-adaptive counterpart. However, there are still research questions yet to be answered that may further increase the effectiveness of AT. In this effort we are comparing within- and between-scenario difficulty algorithms to determine if increasing the rate of difficulty adaptation will lead to more efficient and effective learning outcomes. Adapting immediately, within a scenario, based on in-situ performance should keep the trainee in their Zone of Proximal Development (ZPD) and quickly adapt if a student falls out of their ZPD.

NEED

AT was highlighted as a priority in the Submarine Training Requirements Group letter. AT has also been identified as a solution for COMSUBPAC to satisfy the CNO's High Velocity Learning request. Additionally, AT is in line with ONR's Science and Technology (S&T) Strategy for Warfighter Performance which indicates a need for sailors to received tailored training.

BENEFITS

Current efforts under Scalable, Integrated RF Systems for Undersea Platforms (SIRFSUP) TACAID are addressing on-board training needs in the ESM community by using an Adaptive Training solution. The current effort will provide data to guide adaptation schedule decisions for the SIRFSUP effort in order develop the most cost-effective and efficient method of adaptation for ESM operator training.

STATUS

During the first year of the project, the team has designed an experiment comparing within- and between-scenario difficulty adaptation schedules, as well as a control condition, for a submarine ESM inspired task. The team has also created a graphic user interface that will be used to collect task reports from participants and adapt the training scenarios. Several individual difference measures will also be collected. During the current fiscal year, the team will begin piloting the experiment prior to collecting data from UCF students.

MILESTONES

- Received Institutional Review Board (IRB) Approval.
- Mentoring of two University of Central Florida Human Factors PhD students.
- Created GUI to collect task performance data on ESM inspired task.
- Developed an adaptive engine that assesses and adapts difficulty after each point of assessment.

LEARNING CONTINUUM AND PERFORMANCE AID (LCAPA)

OBJECTIVE

The objective of this effort is to develop methods and technologies to accelerate learning, minimize atrophy, and provide on-the-job performance support that improves individual Sailor performance and enhances mission readiness. This will significantly reduce the cost and time for getting training to the Fleet and increase the Navy's agility in a rapidly changing world.

PAL3 in use

PROJECT DURATION

OCT 2017 - SEP 2021

FUNDING SPONSOR

Office of Naval Research (ONR)

POINTS OF CONTACT

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DESCRIPTION

LCaPA seeks to develop a collection of non-proprietary flexible applications that support an individualized-learning continuum. The program seeks to provide:

- Personalized Guided Study
- Adapting to Skill Decay
- Learner Models
- Mobile Learning
- Ubiquitous Learning
- Virtual Agent Relationship
- Social Motivation
- Persistent Learner Record
- Reuse of existing high-quality resources
- Training Effectiveness Evaluations
- Capturing Sailor's experience
- Intelligent System Updating

NEED

Today Sailors typically attend school and receive most of their rate-specific training up front, which can last up to two years. By the time they reach their assignments their skills could have atrophied or the technology they trained on has become outdated.

BENEFITS

LCaPA's intends to provide Sailors with a career-long learning continuum where training is delivered at multiple points throughout a Sailor's career utilizing modern delivery methods to enable faster learning, better knowledge retention, and reduce skill degradation. With training content being continuously updated and rapidly delivered to the Fleet, an expertly-designed system could bolster Sailors having convenient access to training content and support that is accessible anytime from anywhere. This will significantly reduce the cost and time for getting the training to the Fleet and increase agility in the Navy's rapidly changing world.

MILESTONES

- Effort has moved from the Office of Naval Research's Tech Candidate phase to the Future Naval Capabilities Phase
- In FY18 the Naval Surface Warfare Center Dahlgren Division (NSWCDD) Damn Neck Activity and the University of Southern California's Institute for Creative Technologies (ICT) developed an operational instantiation of the Personal Assistant For Life Long Learning (PAL3) on the Navy's Tactical Services Support Network (TSSN).
- University of Southern California's ICT has migrated the PAL3 system to a mobile interface which will aide in utilization of the system for mobile learning.

MISHAP AWARENESS SCENARIOS AND TRAINING MISHAP AWARENESS SCENARIO TRAINING FOR ENSURING READINESS (MASTER)

OBJECTIVE

Develop a customizable software program that provides outputs to result in a suite of training tools and technologies that supports recreation of aviation mishap events to convey lessons learned and improve safety training through classroom based videos and interactive, immersive visualization techniques.

Aviation survival training seeks to advance mishap awareness training through interactive, immersive visualization techniques such as moderate fidelity training systems.

PROJECT DURATION

SEP 2017 - SEP 2020

FUNDING SPONSOR

Naval Air Systems Command (NAVAIR)

POINTS OF CONTACT

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DESCRIPTION

Advances in virtual reality and computer graphics make it possible to create a software program that allows the user to set a scenario based off of mishap data to recreate mishap events for training leveraging a range of media. The Navy seeks a single scenario development technology that provides inputs to develop a range of training opportunities that are consistent and require minimal investment by the program to continue to expand mishap training scenarios. This system should allow for the development of new scenarios, as well as provide an ability to modify previously created scenarios within the tool through a simplified user interface.

NEED

Spatial disorientation (SD) and situational awareness (SA) are significant contributing factors to the majority of aviation mishap events. The aviation survival training community has requirements to provide sensory physiology/situation awareness training; however, the current training is predominantly classroom based instruction that leverages videos which are not easily updated as new platforms or situations occur.

BENEFITS

Providing a more immersive range of training opportunities will allow for more trainee experience and engagement and likely improve the fidelity and appropriateness of the training. Operator performance will also increase through the ability to better recognize and/or implement emergency procedures when experiencing SD/SA situations, creating safer and more effective warfighter operations.

STATUS

This SBIR has undergone competitive source selection to award Phase II gated approach to three vendors. The awarded industry partners will spend Phase II continuing to develop customizable software tool for the development of mishap training curricula. The rest of the base period, OCT- MAR 2019, will involve conducting demonstrations and designing / developing prototypes.

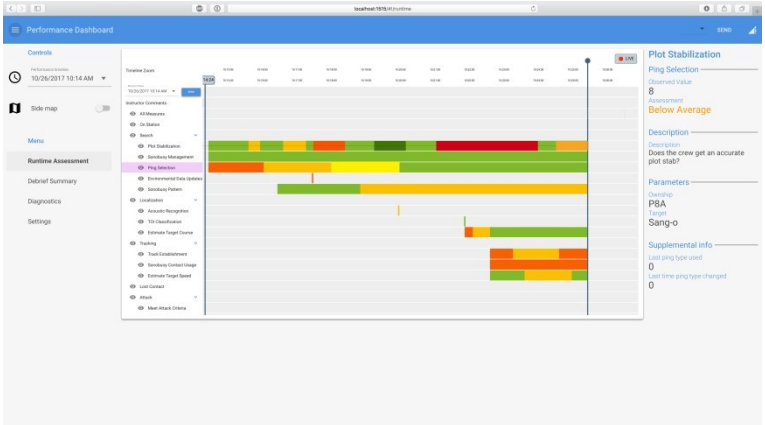
MILESTONES

- Phase I:
  - Kickoff meetings were held with each of the four Phase I contractors, and contractors status was monitored via bi-monthly progress reports and periodic status updates
  - Closeout briefs were held with each of the contractors to discuss Phase I progress and Phase II plans
  - Phase I Option was awarded for three vendors
- Phase II:
  - Phase II gated efforts are in progress

POST MISSION ASSESSMENT FOR TACTICAL TRAINING & TREND ANALYSIS (PMATT-TA): SIMULATION-BASED TRAINING TOOLS

OBJECTIVE

PMATT-TA implements instructional tools for simulation-based training to increase training effectiveness and efficiency automated performance measurement and assessment capabilities that support post event reporting and trend analysis, facilitating a better understanding of aircrew performance and proficiency.



The PMATT-TA Increment 2 instructor interface provides a timeline display with quick access to automated, system-based performance measurement results

PROJECT DURATION

OCT 2010 - SEP 2020

FUNDING SPONSORS

PMA-290; PMA-205; Naval Air Systems Command (NAVAIR) Section 219;
Office of Naval Research (ONR); NAVAIR Small Business Technology Transition (STTR)

POINTS OF CONTACT

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DESCRIPTION

PMATT-TA efforts for simulation-based training tools targets research, development and implementation of a automated system-based performance measures, increased automation for post mission reporting, and technology to support community sustainment and development of performance measures as tactics, techniques, procedures, and mission tasking evolves.

NEED

A Statement of Urgent Need (CPRG, JUN 2010) highlighted the lack of existing Navy products to support force-wide Anti-Submarine Warfare training assessment. The call cited the lack of centralized performance data as the key limiting factor that needed to be address with objective, outcome-based performance data to understand aircrew performance based on measures that provide force-wide tactical proficiency and support targeted remediation via training solutions.

BENEFITS

PMATT-TA's simulation-based training tools increases the reliability and standardization in performance feedback provided to aircrew. PMATT-TA will also assist stakeholders in accurately gauging fleet readiness and competencies in a streamlined and easy-to-use way based on the results of observer and system-based performance measures. The final product seeks to provide a novel technology to view trends in training and performance, ultimately allowing for more informed decision making and proficiency tracking.

STATUS

PMATT-TA's simulation-based training tools underwent extensive testing and integration in FY17-18. Following completion of final testing, the PMATT-TA Performance Dashboard was installed within the P-8 Weapons Tactics Trainer (WTT) as part of Training System Release (TSR)-13 in January 2018. Iterative testing continued in late FY18 as part of a software update for training systems with TSR-14, and will continue in FY19 PMATT-TA's Performance Dashboard version 2.0 and Workbench for TSR-15 (March 2019).

MILESTONES

- Manuscripts/Publications:
  - Atkinson, Tindall, Killilea, Anania. (2018). Advancing performance assessment for aviation training. Proceedings of AHFE.
  - Atkinson, Tindall, Killilea, Tolland, & Dean. (2017). Standardizing human performance measurement for ease of data analytics. Proceedings of the I/ITSEC.
- Presentations:
  - Government Colloquium. B. Atkinson, (2017). Post Mission Assessment for Tactical Training & Trend Analysis. Maritime Patrol Reconnaissance Weapons School; Environmental Working Group.
  - Demonstration exhibit at IITSEC 2017.
- Workforce Development: Mentored junior teammates on program management, interaction for transition, usability analyses, and coordination with fleet customers.
- Transitions: Transition of PMATT-TA Performance Dashboard to PMA-290 with APN funding (FY18-20).

REPURPOSING COMPUTATIONAL ANALYSES OF TACTICS FOR TRAINING ASSESSMENTS

OBJECTIVE

Design and develop a software technology that leverages data science and advanced computational analyses of tactical data sources to improve training scenarios and assessments and make training more adaptive, efficient, and effective.

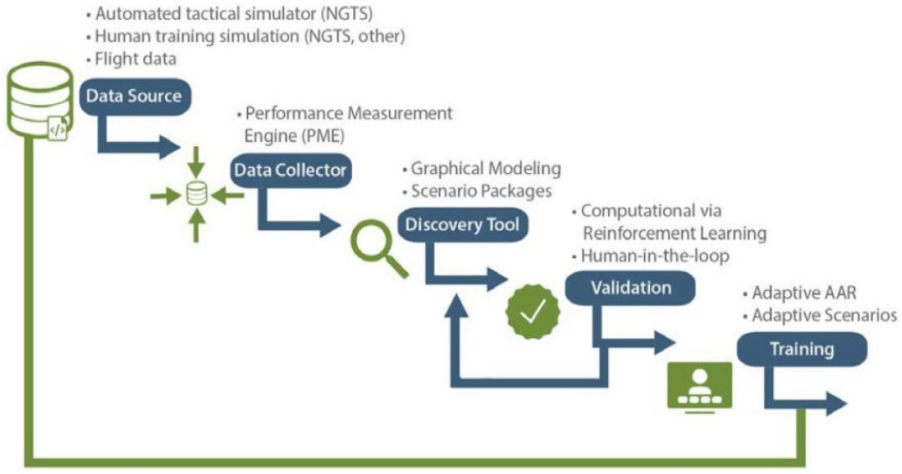

Figure 1. System data flow diagram of TOPMAST.

PROJECT DURATION

SEP 2018- SEP 2021

FUNDING SPONSORS

Naval Air Systems Command (NAVAIR)
Small Business Technology Transition (STTR)

POINTS OF CONTACT

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DESCRIPTION

As the complexity of Tactics, Techniques, and Procedures (TTPs) increase, testing in part via computational simulation and optimization is necessary. Such analyses systematically vary tactical applications of the warfare capability to a variety of threat scenarios, simulate and score each encounter, and generate a ranked list of the most successful tactics per threat. The scenarios, measures, and knowledge generated in this type of work are rich and voluminous, providing opportunities to leverage data science. This effort seeks to deliver a software technology solution capable of re-using analytic data outputs for populating training content.

NEED

Emerging warfare capabilities offer a great many new tactical options to commanders. However, this also increases the demands on decision-makers during operations. The dynamic and complex nature of integrated warfare results in training challenges to prepare for those engagements. To address this need, this effort seeks: 1) the capability to generate scenario libraries, and 2) the ability to improve integrated assessments of human tactical skills to make training more efficient and effective.

BENEFITS

Navy leadership has called for technologies that support analytics of big data sets such as avionics and human performance; however, as new systems or technologies are introduced and/or new tactics emerge to maintain superiority, existing training scenarios can quickly become obsolete. Advance statistical or novel modeling techniques are sought to address the unique challenge of ensuring training scenarios are current.

STATUS

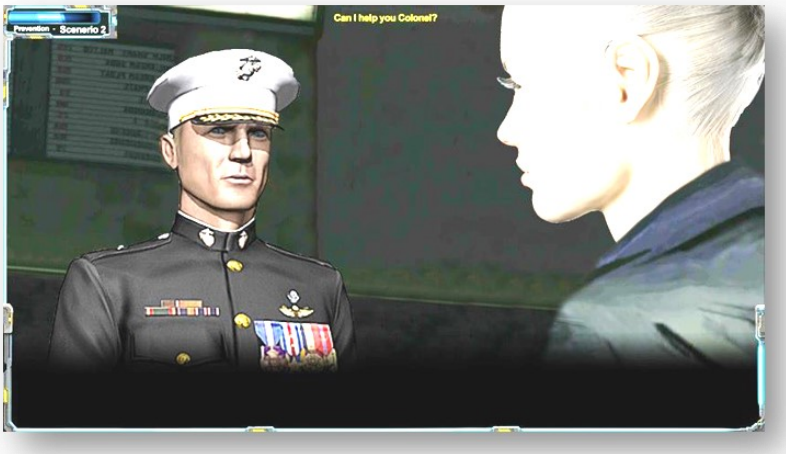
This STTR has completed Phase I efforts by three vendors. Closeout briefs were held in September FY19. We are currently reviewing proposals to make phase II award decisions with an award targeted for Q2 FY-19.

MILESTONES

- Phase I:
  - Kickoff meetings were held with each of the three Phase I contractors
  - Contractors status was monitored via bi-monthly progress reports and periodic status updates
  - Closeout briefs were held with each of the contractors to discuss Phase I progress and Phase II plans
- Phase II:
  - Phase II proposals are under review
  - Phase II awards are targeted for Q2 FY19

SEXUAL ASSAULT PREVENTION AND RESPONSE (SAPR) VIRTUAL IMMERSIVE TRAINING

OBJECTIVE:
To create training that will prepare Navy and Marine Corps Officers and Senior Enlisted personnel for their respective roles and responsibilities in preventing and responding to sexual assault. This is in addition to the sexual assault prevention training provided to all personnel through required General Military Training.



SAPR Officer and Senior Enlisted Interactive Training Environment

PROJECT DURATION
JAN 2016 - SEP 2019

FUNDING SPONSOR
Department of the Navy (DON), Sexual Assault Prevention and Response (SAPR) Office

POINTS OF CONTACT
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DESCRIPTION
This effort involves the creation of online/web-based virtual immersive Sexual Assault Prevention and Response training that includes the development of course goals, learning objectives, curriculum, interactive knowledge assessments, reference materials, and adaptive training scenarios for Navy and Marine Corps Officers and Senior Enlisted personnel. This training will include challenging and compelling SAPR decision making scenarios that adapt to the user's responses and will provide individualized feedback at the end of each scenario.

NEED
Sexual assault is devastating to victims and can greatly impact a Unit's mission readiness and effectiveness. It is imperative that senior and mid-level managers understand the Navy and Marine Corps program for prevention and response, and their responsibilities.

Requirements for this training are outlined in Department of Defense Instruction 6495.02 and SECNAV Instruction 1752.4B.

BENEFITS
The Navy and Marine Corps' Sexual Assault Prevention and Response program is complex and includes aspects required by law. In order to administer the program correctly and ensure protection for the victim and the accused, the proper conduct of an investigation, the preservation of evidence, the roles of assisting personnel (victim advocates, legal, investigative, and medical) and sexual assault response services, Navy and Marine Corps Officers and Senior Enlisted personnel must understand their responsibilities if an assault should occur. The training developed from this effort will ensure that the Navy and Marine Corps program is correctly managed.

STATUS
The Navy and Marine Corps Sexual Assault Prevention and Response course curriculum, interactive training scenarios, and testing materials were delivered to the Department of the Navy SAPR Office in February of 2018.

Creation of the web-based virtually immersive portion of this effort will begin in FY19, with completion expected by September.

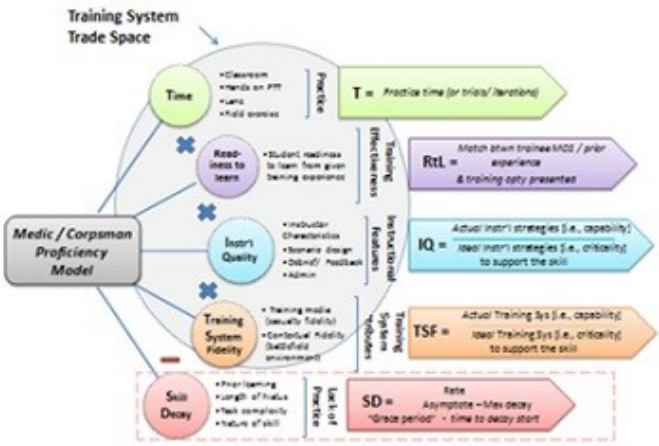
MILESTONES

- Transition: Sexual assault prevention and response course curriculum, learning objectives, interactive training scenarios and assessment materials were developed and delivered to the Department of the Navy Sexual Assault and Prevention Office in February of 2018.

SYSTEMATIC TEAM ASSESSMENT OF READINESS TRAINING (START) APPLIED TO MEDICINE: MEDIC/CORPSMAN PROFICIENCY MODEL (MED-PM)

OBJECTIVE

To develop a medical skills proficiency model and training trades space analysis tool yielding decision quality results for training and acquisition stakeholders. The tool will provide diagnostics of the health or capability of the system to produce proficient learners; 'what if-ing" of alternative training system configurations considering the impact on proficiency attainment; and present outputs - training requirements and training system health metrics - in intuitive visualizations.



Med-PM proficiency model and trades space.

PROJECT DURATION

OCT 2016 - SEP 2018

FUNDING SPONSOR

Defense Health Agency (DHA) / Joint Program Committee (JPC) -1

POINTS OF CONTACT

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DESCRIPTION

The Med-PM project is a phase 2 effort that builds upon and extends prior and concurrent DoD and DHA funded work. A model of Combat Medic/Corpsman proficiency is being built leveraging heavily from NAWCTSD's Navy Aviation Proficiency Model. The medical proficiency model is at the core of a trade space analysis tool representing learner and training system factors over which trainers and acquisition stakeholder have influence. An analysis and visualization suite will allow stakeholders to analyze current and notional training configurations and the resulting impact on proficiency, and generate results in graphics designed specifically to facilitate communication of complex information.

NEED

Training initiatives such as Tactical Combat Casualty Care (TCCC) have made a tremendous difference in preparing medical providers to save lives on the battlefield. Conflict exists however, over those medical skills training approaches that include animal simulation. Increasing pressure from advocacy groups to eliminate live tissue training gives rise to the need for modeling and analysis methods to examine the impact of alternative training approaches on medical skills development.

BENEFITS

From an applied perspective, the medical proficiency model and trade space analysis tool will optimize training and acquisition decisions; and from a research and development perspective, identify gaps in applied learning science.

More specifically, Med-PM will identify strengths and gaps in existing TCCC training programs related to time to train, training system fidelity (media and environment), instructional capabilities and student readiness to learn; and allow decision makers to make informed investments related to curricula changes and / or technologies.

STATUS

The project is entering Year 2, during which:

- a skill acquisition and retention framework will be refined to improve model algorithms (proficiency acquisition and skill decay for different task and learner types).
- the model will be instantiated in a software tool with an intuitive user interface including a training system health dashboard.
- a pilot experiment will be conducted. TCCC course will be modeled and compared to learning requirements.

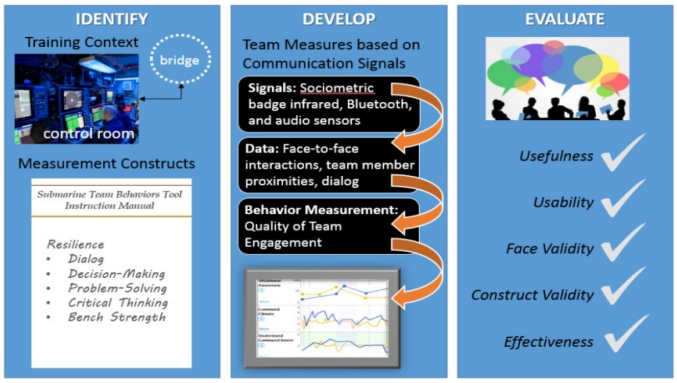
MILESTONES

- Awarded 3 contracts to support:
  - Skill Acquisition and Retention Framework enhancement
  - Med-PM trade space analysis tool development
  - Training venue modeling

TEAM-BASED ADVANCED RESILIENCE ACCELERATOR (TARA)

OBJECTIVE

Develop a prototype system called Team-based Advanced Resilience Accelerator (TARA) for tracking observed behaviors during Submarine team training, especially teamwork and team resilience skills. TARA will enhance briefs and After Action Reviews (AARs) by providing concrete descriptions of training objectives as well as immediate post-training access to data-driven visualizations of team performance. These features will facilitate instructors as they provide descriptive and prescriptive feedback and make recommendations for future training that target areas of weakness within the team.



TARA system concept

PROJECT DURATION

SEP 2017 - SEP 2019

FUNDING SPONSOR

Naval Aviation Training Systems Program Office (Program Management Activity [PMA] 205)

POINTS OF CONTACT

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DESCRIPTION

The proposed research and development effort will expand on existing solutions to develop TARA, a team behavior measurement and feedback system that will support coaching, mentoring, training, and self-assessment of team skills. Ultimately, TARA will support performance assessments over time to allow instructors and teams to discover the deep connections that exist between their actions, the task conditions, and outcomes, which will provide them with the foundation they need to act and make intuitive decisions as a resilient team. The TARA system is comprised of Submarine SPOTLITE, for online assessments and immediate performance feedback, and Learning Locker, for storing and tracking team performance over time. Together, these provide benefits for instructor and trainee in terms of understanding a team's strengths and weaknesses, and by using this knowledge to select the optimal training path for the team.

NEED

NAE Science & Technology Objective Alignment: 10. Naval Warfighter Performance (NWP) Capability Gap (10.1 NWP STO-1: Training and Education)

Submarine Learning Center expressed an interest in streamlining and enhancing team assessment and team training within scenario simulation trainers and provided a letter of support for this effort.

TARA will result in the accelerated development of resilient team skills that are needed for the team to perform effectively and efficiently when on duty. Performance assessment and targeted/adaptive training is needed to accelerate these skills, but instructors are already overworked in these environments. Providing tools to assist the instructor are needed; TARA meets this need.

BENEFITS

The proposed work will benefit the Submarine Force by providing advanced resilience training to tactical teams at all five levels of training practices: Formal Schools, Formal Qualification, Continuing Training, Inspection and Certifications, and Self-Assessment. These teams will be better equipped to recognize danger and seize opportunity in times of uncertainty, as well as being able to adapt to changing situations. This effort aims to improve the effectiveness and efficiency of training by improving assessment quality and feedback, tailoring training experiences based on past performance, and potentially reducing training time by excluding learned activities.

STATUS

The Contract for this effort was awarded on September 19, 2017 and is currently in the beginning of the second year of effort. The first annual technical review of this effort took place September 2018. The FY19 effort will involve the software development and integration of the tools to include live performance tagging, team member self assessment, and AAR capabilities.

MILESTONES

FY19 Deliverables:

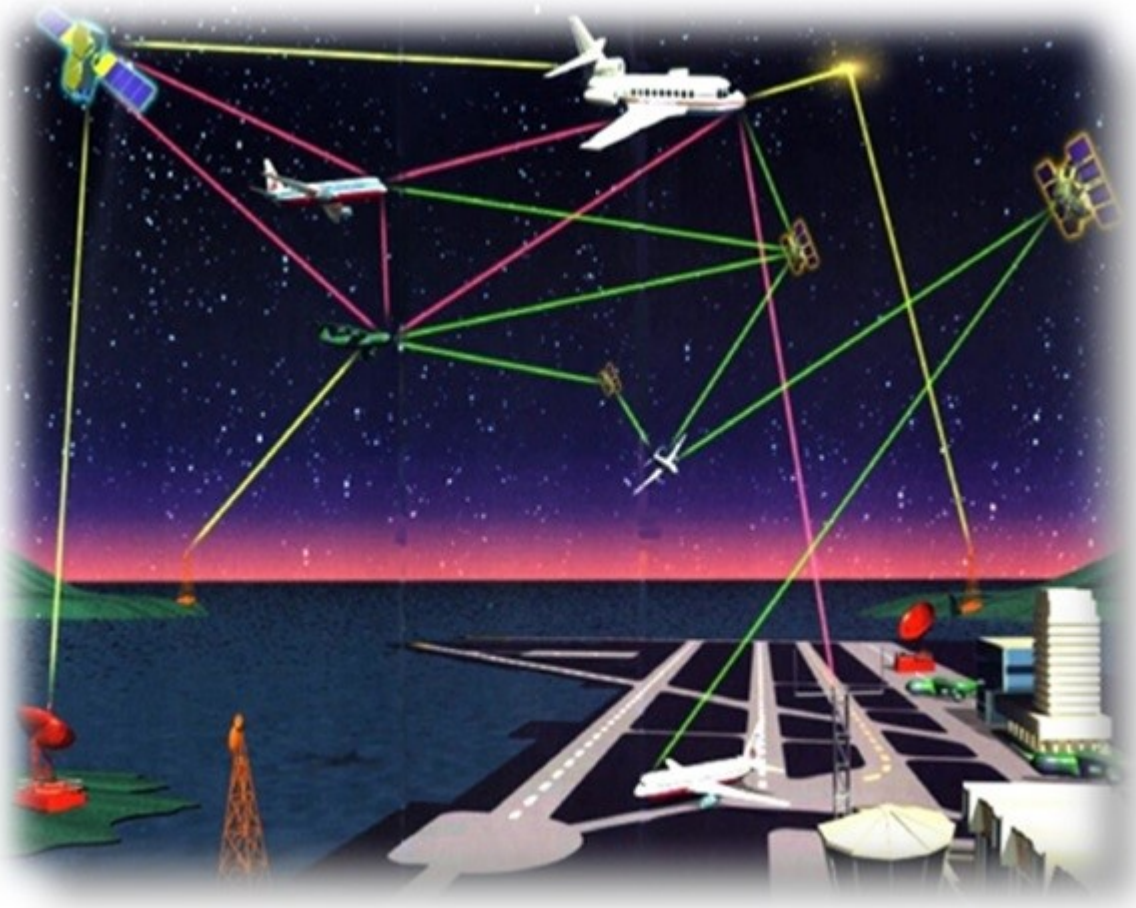
1. Demonstration of TARA to Submarine Learning Center
2. Quarterly Government Progress Reports
3. Yearly Progress Review Presentation and Slides
4. Final Report and Demonstration (Sep 19)

CORE CAPABILITY 3:
ADVANCED TRAINING SYSTEMS TECHNOLOGY

Training systems, such as LVC simulations, provide an appropriate mix of environments where learners can interact in real time with each other using networked devices. Technology can augment warfighter preparedness by providing training opportunities that might not be available due to factors such as cost, safety, and resource availability. Training technology includes the ability to provide realistic rendering and modeling, multisensory input/output devices (e.g., visual/audio/haptic displays, speech recognition, and flight control sticks), and system interconnectivity such as web servers, networking bandwidth, and processing speed).

The following Technology areas comprise this Core Capability:

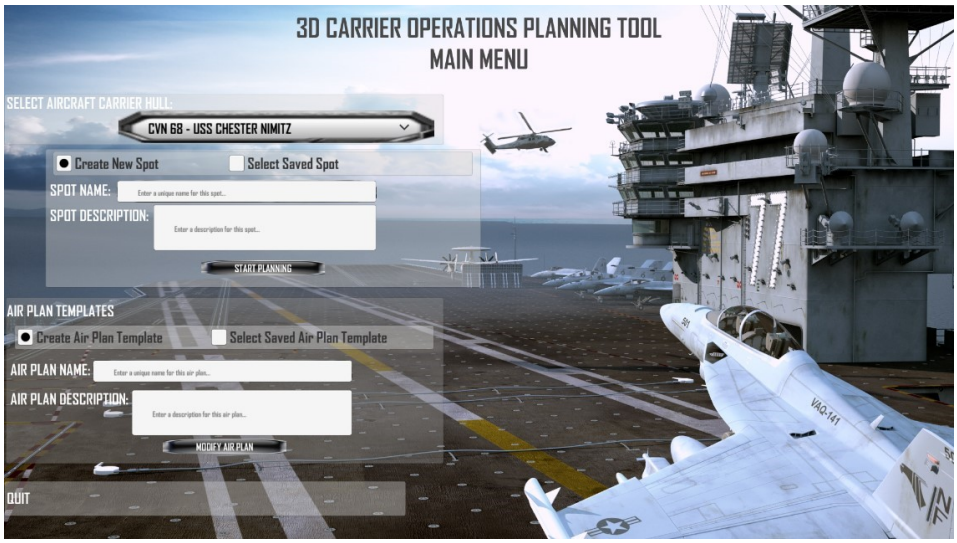
- High-Fidelity Training Environments
- Simulation Interoperability and Distributed LVC Technology



3D INTERACTIVE AIRCRAFT CARRIER OPERATIONS TRAINING TOOL

OBJECTIVE

Current 2D Aircraft Carrier Planning Tools (ADMACS Digital Ouija Board and the Traditional Ouija Board) have several limitations for planning and training. These current toolsets do not allow the crew to visualize danger areas or planning issues. The tools also do not allow the aircraft spot to be simulated or checked for errors. The research from the effort investigated solving these issues using the newest 3D game engine tools for design and simulation.



Main Menu of 3D Carrier Operations Training Tool - can create an air plan or new spot.

PROJECT DURATION

OCT 2015 - SEP 2018

FUNDING SPONSOR

Naval Air Systems Command (NAVAIR) | Section 219

POINTS OF CONTACT

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CDR Wilfred Wells
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DESCRIPTION

FY16: Developed a 3D Aircraft Carrier Operations Training Planning Tool prototype for Planning mode

FY17: 1) Added Operations mode and finalized prototype, 2) Conducted heuristic evaluation and comparison of the prototype to the existing Ouija board planning tool

FY18: Transition the product as a training tool to the Center for Naval Aviation Technical Training (CNATT).

NEED

There is currently no training tool that teaches the Aviation Boatswain's Mates, Handlers (ABHs), the flow of aircraft on deck, or the cause and effect relationship between the aircraft spot and execution of the air plan. They only receive on-the-job training (OJT) as they rotate through various positions.

BENEFITS

This training tool would fill the critical training gap by allowing ABHs to understand the flow and cadence of aircraft during operations and train them how the initial spot of those aircraft on deck affects operations throughout the day. This tool would also allow for training of abnormal and emergency conditions aboard ship, which is currently a capability that does not exist.

STATUS

The project is entering its final year. The project will result in a technology transition of the training/software planning tool to CNATT in FY18.

MILESTONES

- Completed training tool software and technology transition to CNATT.

CNATRA T-45 VR-PTT TRAINING EVALUATION

OBJECTIVE

Investigate feasibility of using Virtual and Augmented Reality to replace legacy visual systems in OFTs to reduce cost and increase capability of high physical fidelity flight simulators such as the T-45 OFT.

T-45 VR-PTT

PROJECT DURATION

MAR 2018 - SEP 2019

FUNDING SPONSOR

Naval Aviation Training Systems Program Office (Program Management Activity [PMA] 205)

POINTS OF CONTACT

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DESCRIPTION

The Research Psychologists in NAWCTSD's Science for Training Evaluation, Analysis, Learning and Theory (STEALTH) Lab are developing and executing a training evaluation plan for a T-45 Virtual Reality Part Task Trainer (VR-PTT) for the purpose of informing CNATRA and PMA-205 leadership on the effectiveness of the devices to improve training and desired training outcomes (e.g., performance in the aircraft, reduction in re-flys).

NEED

The Navy needs to continue addressing Naval Aviation Simulation Master Plan (NASMP) IV Priority 5: "Continue strategy refinement to provide a basis of understanding the potential for leveraging technology to solve the training challenges of the future.

BENEFITS

If effective, the Navy could replace some in air training with new part task trainer. Also, this study has the opportunity to show VR being used effectively in a training environment.

STATUS

This project kicked off 30 Mar 2018. The two T-45 VR PTTs have been delivered to NAS Kingsville.

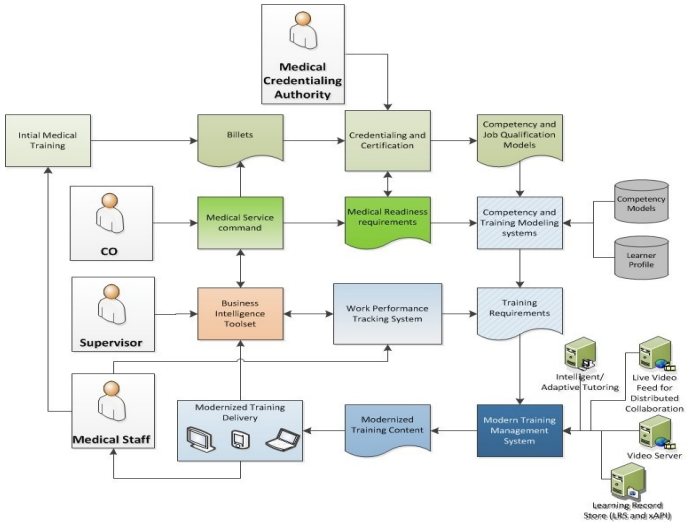
MILESTONES

- Delivered (5 Dec 2018) Two prototype T-45 virtual reality part task trainers (VR PTT): HMD, stick, throttle, & rudder; interface w/ ARVS

DEFENSE HEALTH AGENCY (DHA) TOTAL LEARNING ARCHITECTURE (TLA) LEARNING TECHNOLOGY ROADMAP WITH CONCEPT PILOTS

OBJECTIVE

The goal of the effort is to begin the ambitious task of moving the DHA community to a holistic learning architecture. The Total Learning Architecture (TLA) will attempt to define DHA's unique learning needs, strategies to present them, and mechanisms to deliver them.



Systems view of the proposed Defense Health Agency Total Learning Architecture. This views show the content and data flow from staff training to work performance enabling adaptive training, modern learning technologies, and "right place, right time" access to training.

PROJECT DURATION

NOV 2017 - APR 2019

FUNDING SPONSOR

Defense Health Agency (DHA) - Research and Development (J9)

POINTS OF CONTACT

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DESCRIPTION

NAWCTSD's Modern Learning Strategies (MLS) team, with academic and industry partners, will develop the technology roadmap necessary to enable a TLA. The roadmap will document current medical learning environments needed and in use, as well as the instructional methods, systems, and infrastructures required by the conceptual TLA. The team will work with DHA to identify existing instructional courses that would be appropriate to use as the basis for TLA pilots. The scope of the current effort includes execution of two instructional course pilot efforts.

NEED

A TLA is a critical enabler for the effective structure and organization of training continua. Without it, mechanisms for evaluating curriculum structure and learning effectiveness are either absent or piecemeal efforts. A TLA is needed to provide visibility across the training continuum. The TLA cannot be achieved without prerequisite analyses of the state of training, a technology roadmap, and pilot programs for development and evaluation.

BENEFITS

Development and transition of a TLA roadmap will help ensure that curricula are yielding effective learning, and structured to optimize resources of time, materials, and funding. This will include not only pedagogical evaluation to ensure that content is structured to maximize learning, but also information assurance, systems interoperability, and courseware and content delivery requirements across training media and information systems. The supported TLA will be a critical enabler of training delivery, optimized structure, and effectiveness evaluation.

STATUS

This is a new effort, kicked off in early FY18.

- Phase I consists of an analysis and initial investigation for the development of a DHA Learning Technology Roadmap to be delivered in outline form.
- Contractor shall research and document DHA learning initiatives and requirements.

MILESTONES

- DHA leadership has accepted and approved the effort
- Phase II will see delivery of draft format and a finalized DHA Learning Technology Roadmap
- Phase III contractor shall commence the TLA Pilot courses authored during phase one

DYNAMIC FLIGHT SIMULATION AS A SUPPLEMENT TO IN-FLIGHT PILOT TRAINING

OBJECTIVE

Aptima and Soar Technology are conducting a follow-on effort to extend the work achieved under the Carrier Qualification Training Reduction via Advanced Piloting System (CQTRAPS) contract. The purpose of this effort is to advance the capabilities of the single Landing Signal Operator operational trainer, known as the LSOT, resident in the LSO School at NAS Oceana through the incorporation of three products driven by analytical, computational, and data modeling based on real world aviation system and SME data.

PROJECT DURATION

OCT 2016 - OCT 2018

FUNDING SPONSOR

Naval Air Systems Command (NAVAIR) | Naval Aviation Training Systems Program Office (Program Management Activity [PMA] 205)

POINTS OF CONTACT

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DESCRIPTION

In an effort to mitigate the predicted impact of training optimization on the LSO training pipeline, this effort will provide a rich data set for a working computational model to ensure accurate, real life approaches for training and the development of more accurate flight models based on emerging technologies and pilot proficiency levels. In addition, the data will inform scenarios, events, and metrics for inclusion in the training scenarios for pilots, LSOs, and other Air Ops teams (e.g., Air Boss).

NEED

LSOT deficiencies that are realistic and data driven are requirements being prioritized to Type Commander (TYCOM) and at Enabler Naval Aviation Requirements Group (ENARG) via Force Paddles and the LSO School Office in Charge. In addition, the Precision Landing Mode (PLM) install is being tested for implementation next Fiscal Year and will drive requests for Carrier Qualification (CQ) training and changes to Field Carrier Landing Practice (FCLP) requirements. This effort will help improve training technology for pilots, LSOs, and Primary Flight Control (Pri-Fly) and provide supporting data for recommendations.

BENEFITS

There is currently only a single LSO trainer (LSOT) located at NAS Oceana in the LSO School. Because of this limited availability, the throughput and maintenance of this device is a difficult problem to manage for LSO instructors and PMA-205 LSOT program managers. Analytical and computational models, as well as a baseline Landing Quality Index to assess CQ and inform LSO training and currency will add to the training value and inform acquisition and currency decisions. By using live data, this scientific effort will help the development of more realistic models and provide additional instructional capabilities that can be implemented in existing and re-hosted LSOT, as well as provide objective data for recommendations.

STATUS

Currently at the end of year one, the data have been cleaned and parsed and as a result stand ready for a number of different kinds of analysis. The LSO live data set was used to compute initial landing quality index scores and to begin identifying patterns. The team completed implementation of the threshold level model-simulation API for the Year 1 model.

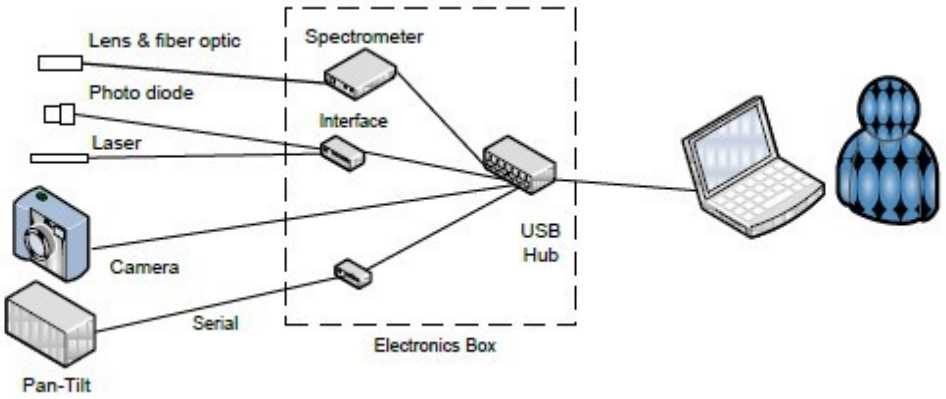
MILESTONES

- Created an application that read in all text files in each of the subdirectories and created two comma-separated values (csv) files, one for each subdirectory representing 959,016 traps.
- Developed a grammar that successfully parsed most of the LSO's glideslope comments on the 1500 or so traps in the data set.
- Performed some simple analyses on the resulting data set.
- Developed an initial functional (but incomplete) model of carrier landings. This model flies from the beginning of the groove pattern and "lands" via gradual descent and control maneuvers of the aircraft.
- Implemented the threshold level model-simulation API model and, using the Raft model-simulation interface middleware, developed test capabilities and test scenarios to test API functionality.
- Integrated the model development environment and implemented the initial model, using the goal decomposition developed in consultation with LSO School.

EFFECTIVE MEASURES OF TRAINING DISPLAY SYSTEM PERFORMANCE

OBJECTIVE

To develop an objective and efficient measurement toolkit for conducting validated acceptance tests for simulation training display systems.



The proposal was for Visual Performance to develop a Display Measurement Toolkit which included a number of sensors including camera, spectrometer, laser and photodiode on a pan and tilt mount which allows for benchmarking display system performance.

PROJECT DURATION

SEP 2016 - MAR 2018

FUNDING SPONSOR

Naval Air Systems Command (NAVAIR)

POINTS OF CONTACT

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DESCRIPTION

Despite significant technological advances, the Navy's visual system acceptance tests are still manual, time consuming, and often inconsistent across programs. Significant improvements in the certification process are available through the application of modern metrics and more automated methods of measuring display systems. These improvements would save both time and cost of training display system certification, as well as improve the performance level of such systems.

NEED

Over the past decade, the ability to measure essential display system attributes has advanced to the point where the simulation training industry has multiple suppliers who offer automated display calibration systems, capable of accurate geometry and channel-to-channel co-alignment. However, typical acceptance tests used to certify training display systems are still manual, time consuming, and often inconsistently applied across programs.

BENEFITS

This effort will benefit the Navy by developing innovative metrics, measurement procedures and hardware that are needed to support the certification of simulation training devices.

STATUS

Prototyping of metrics and hardware of a potential Display Measurement Toolkit were developed by the contractor. The prototypes include pan and tilt mount and high-resolution digital color camera. Tested metrics included: system resolution, sampling artifacts, contrast, luminance and geometry. Prototype geometry and resolution metrics were compared against traditional testing methods and documented in reports.

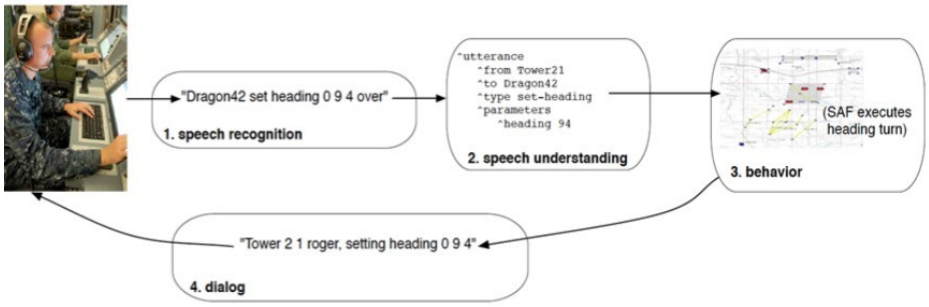
MILESTONES

- ◊ Phase I Effort completed in 2016.
- ◊ Prototype system demonstrations for resolution and geometric metrics.
- ◊ Phase II completed Mar 2018
- ◊ Contractor submitted final prototype and demonstration to NAWCTSD

END-USER SPEECH RECOGNITION SUPPORT TOOLS FOR CREW RESOURCE MANAGEMENT TRAINING SYSTEMS

OBJECTIVE

Develop an innovative software capability to improve the utility of structured automatic speech recognition (ASR) by allowing end-users to customize the set of supported utterances without external support.



A sample speech recognition and understanding process

PROJECT DURATION

AUG 2017 - JUL 2020

FUNDING SPONSOR

Naval Air Systems Command (NAVAIR)

POINTS OF CONTACT

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DESCRIPTION

The resulting software capability should be modular and flexible in nature to allow multiple aviation platforms to leverage the functionality. For example, consider U.S. Naval aviation crews that conduct similar mission sets, but have their own unique doctrinal phraseology. Although each platform may prosecute an antisubmarine warfare (ASW) mission similarly, their doctrinal phraseology is likely specific to their respective platforms. The solution should have enough flexibility to account for platform specific changes, or multiple platform accommodations. Further, the resulting software capability should include up-front "train the speaker" modules.

NEED

ASR successes within simulation-based training systems have been modest. Some domains have overcome the complex challenges that exist in implementing ASR by making use of enforced doctrinal phraseology, which the speech recognition technologies can exploit. However, in more complex and fluid training environments that are less structured, more complex natural-language processing techniques are necessary to achieve that purpose. These environments require ASR systems with the flexibility for the instructor to customize and edit the feature.

BENEFITS

This effort seeks to provide a capability for end users of ASR-enabled training systems to edit or customize the feature to better match their particular needs, which is a significant system upgrade. Within military domains where tactics and protocols adapt over time, so the technology sought should provide training personnel with functionality to append a particular phrase or a specific term to the existing grammar.

STATUS

This STTR has undergone competitive source selection to award Phase II. Currently, two performers were selected to move forward with a gated Phase II. The two performers were selected as they both came to the problem with unique and innovative solutions to the STTR topic. The selected performers have conducted feasibility analyses, designed and developed prototypes, and are now turning the prototype systems into full technology capabilities.

MILESTONES

- Phase I:
  - Kickoff meetings were held with each of the Phase I contractors
  - Contractors status was monitored via bi-monthly progress reports and periodic status updates
  - Closeout briefs were held with each of the contractors to discuss Phase I progress and Phase II plans
  - Phase I Option was awarded for two vendors
- Phase II:
  - Phase II contract awarded in October 2018 and initial technical work is in progress

EXPLORATION OF KINESTHETIC AND HAPTIC TECHNOLOGIES IN VIRTUAL TRAINING ENVIRONMENTS

OBJECTIVE

The objective of this effort is to enhance a virtual reality (VR) trainer with the ability to teach physical procedures while providing the user with haptic feedback. This will involve a full exploration of the various commercial off-the-shelf wearable haptic devices. We will implement a virtual, full hand simulation and provide both textural and thermal feedback as well as realistic physical resistance in an immersive VR environment.

LCDR Ryan Kramer explores a simulated Virginia class submarine in the VR prototype for the Virtual Interactive Shipboard Instructional Tour® (VISIT®).

PROJECT DURATION

OCT 2017 - SEP 2019

FUNDING SPONSOR

Naval Air Systems Command (NAVAIR) | Section 219

POINTS OF CONTACT

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DESCRIPTION

Our development will focus on integrating various haptic devices with the HTC Vive (VR Head Mounted Display) and Unity (software gaming environment). Each haptic device comes packaged with an Application Programming Interface (API) and a Unity plugin that we must research thoroughly before device testing can begin. Once the various Software Development Kits (SDKs) are fully understood, appropriate tests can be developed to explore the strengths and weaknesses of each device. We will test the ability of each device to perform specific tasks such as turning valves on a submarine and operating controls necessary to perform maintenance on the E-28 aircraft arresting gear.

NEED

Haptic devices are an emerging technology and their training benefit has yet to be fully explored and validated. There is a strong demand signal for VR training using these novel, emerging devices. The primary reasons are twofold: (1) the requirement to reduce cost to develop and maintain training, and (2) the desire to provide just-in-time training anywhere, independent of location .

BENEFITS

The knowledge gained during this effort will be leveraged into proposals for customers and serve as the framework to build test beds or prototypes with the plan to transition them into production ready training products such as VISIT 3D™.

STATUS

The FY19 Execution Plan is as follows:

Procurement: New devices are released every year. We will purchase the Dexmo Exoskeleton and investigate other emerging devices.

Capability Assessment: Conduct a pilot usability study documenting strengths and weaknesses of each device.

Integration Experiments: Attempts to integrate the devices into existing 3D training systems and determine their effectiveness.

Usability Studies and Conclusion: Document lessons learned and develop a product usability report.

MILESTONES

In FY18, we explored the latest haptic technologies and their associated software development kits. Upon mastery of the APIs, we developed performance and capability tests for each platform. We met our goal to procure and explore, at least, five unique devices.

In FY19 it is our goal to demonstrate the use of these devices in existing virtual training environments. We plan to conduct a thorough assessment of the technology as it relates to warfighter training and document the results.

EXTENDED FIELD OF VIEW (FOV) VIDEO AVIATION TRAINING AIDS

OBJECTIVE

Investigate the viability of improving initial flight training by comparing traditional training methods to use of these methods augmented by the incorporation of extended FOV video.

The T-6A Texan II is a tandem-seat, turboprop trainer whose mission is to train Navy and Marine Corps pilots and Naval Flight Officers.

PROJECT DURATION

OCT 2017 - SEP 2019

FUNDING SPONSOR

Naval Air Systems Command (NAVAIR) | Section 219

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DESCRIPTION

Two populations of student aviator performance will be measured and compared on targeted primary flight syllabus events. During mission planning and rehearsal, the first group will utilize traditional "chair flying" techniques, in which student aviators mentally rehearse for upcoming events by walking through checklists, procedures, and decision points. The second group will have access to extended FOV video recordings of the event that provide perspective on task load, timing, sequence, and spatial orientation of visual and audio cues the student could expect to see during the event.

NEED

360° video and VR training technology are rapidly becoming mainstay, and vendors continue to penetrate senior leadership ranks with promises of effectiveness. Empirical evidence of the effectiveness of these training media for the undergraduate military flight curriculum is urgently needed by PMA and resource sponsor decision makers to help these and other NAE stakeholders make better informed decisions about capability purchases. We need a much stronger body of literature regarding the utility of VR for aviation training.

BENEFITS

Incorporating extended FOV video into training could yield faster orientation to challenging mission types, as students would already have exposure to the visual and audio cue and decision sequences they could expect to see. The simulator and flight time typically required to develop situational awareness to a new flight regime could be potentially reduced.

STATUS

With input from CNATRA Rotary Wing Pipeline Training Officer, gaps identified in TH-57 Basic syllabus and three key sorties selected for augmentation with Extended FOV Video Aviation Training Aids. Stereoscopic 3D video capture rig and Virtual Reality display hardware procured. Flight clearance in process to capture video with FRS at NAS Whiting Field.

MILESTONES

- Identification of representative sorties in TH-57 (completed March 2018)
- Design metrics and experimental design (December 2019)
- Conduct recording and playback media analyses (January-March 2019)
- IRB Approval (April 2019)

FLIGHT DECK CREW REFRESHER TRAINING EXPANSION PACKS (TEP)

OBJECTIVE

The objective of this effort is to create an expandable framework of game-engine-based, immersive 3D Flight Deck Crew Refresher Training Expansion Packs (TEPs) for use by trainees in Fleet Concentration Areas (FCAs). The TEPs shall allow for individual, team, or multi-team training events, and shall utilize appropriate combinations of state of the industry immersive technologies, including virtual reality.

Screenshot of actual 3D flight deck and aircraft models used for the effort.

PROJECT DURATION
JUL 2017 - AUG 2018

FUNDING S PONSOR
Office of Naval Research (ONR)

POINTS OF CONTACT
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DESCRIPTION

The NAWCTSD team intends to focus development on the overall system baseline architecture, the Primary Flight Control (Pri-Fly) TEP, and its connectivity to the Landing Signal Officer (TEP) by following a proven development approach which incorporates streamlined System Engineering Technical Reviews (SETR) and interim Fleet progress reviews. NAWCTSD will utilize its expertise in the science of learning, individual and team training, and human performance to ensure the technology and content addresses the training needs of the audience through a task analysis, metric development, and include a Training Effectiveness Evaluation (TEE).

NEED

Flight Deck Crew readiness, refresher, and certification training opportunities are limited. The training pipeline and available technology for flight deck crew initial training is often limited or outdated. Flight deck crew members are often sent to other underway carriers for refresher training and readiness sustainment. This is costly to the ship and logistically challenging. This practice results in crew members not training with their actual team members. New Ford Class carrier crew members are not training on the correct ALRE gear.

BENEFITS

- Increase readiness, refresher, and certification training opportunities for aircraft carrier flight deck personnel by providing training at FCAs for individual, teams, and multi-team coordination.
- Allow for single trainee, single team, and multi-team training opportunities for flight deck crews.
- Prevent stovepipe training solutions for flight deck crews.
- Target crew specific ALRE and flight deck parameters (e.g., Legacy Steam Catapults vs EMALS).
- Include technologies that allow trainees to use realistic communications and equipment and provide an immersive environment for the trainee with the appropriate fidelity.

STATUS

The Primary Flight Control (Pri-Fly) and Landing Signal Officer (LSO) Editions were delivered to the LSO School in NAS Oceana in FY18. The Catapult Launch Team was delivered to CNATT in FY18. All three teams will receive updates and additional functionality in FY19.

MILESTONES

- Final system:
  - Pri-Fly TEP with connectivity to LSO and/or Catapult Crew
  - Software Baseline Architecture for connectivity of all future TEPs
- Documentation:
  - User Manual
  - Technical Manual
- Final report, to include:
  - Ending technology readiness level (TRL): TRL Level 6
  - The Training Effectiveness Evaluation (TEE) results and analysis shall also be presented at the demonstration and a final report will be made available to the Fleet at the end of the effort.

IMMERSIVE PARACHUTE DESCENT PROCEDURE, MALFUNCTION, AND DECISION-MAKING TRAINING SYSTEM

OBJECTIVE

Develop a novel reconfigurable device training system that provides immersive Parachute Descent Procedure (PDP), malfunction and decision-making training to allow the survival training community to deliver cross-platform training without the need for multiple training systems or platform specific peripherals.

Naval Aircrewman Operator 1st Class Michael Griffin, an instructor with Aviation Survival Training Center Jacksonville, right, runs the virtual reality parachute descent trainer, while making sure Naval Aircrewman Operator 1st Class Albert Flores with Patrol Squadron 10 correctly runs through his descent procedures. The trainer is designed to give students a realistic feel for parachute steering, allowing them to experience and correct potential problems when a parachute deploys.

PROJECT DURATION

JUN 2016 - SEP 2021

FUNDING SPONSOR

Naval Air Systems Command (NAVAIR) | Small Business Innovative Research (SBIR)

POINTS OF CONTACT

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DESCRIPTION

This project is a Small Business Innovative Research (SBIR) project targeted at researching, designing, and developing a novel, immersive training system that provides the ability to train aviators by addressing three capabilities gaps: 1) training quality and effectiveness, 2) supportability, and 3) training realism. The training system should provide a reconfigurable interface that supports all Navy standard flight equipment and parachute equipment. Developed technology would provide the ability to demonstrate effectively both standard procedures (e.g., inflation of the life preserver, releasing the raft when applicable) and parachute malfunctions.

NEED

Current parachute procedure safety training is based on technology that has inadequate effectiveness and realism, primarily due to limitations that prevent interfacing with standard flight and parachute equipment. An advanced training solution will provide a reconfigurable connection for a variety of aircrew equipment and seat kits, which differ by platform.

BENEFITS

Cross-platform survival training, without the need for multiple training systems, will help avoid potential training costs, as well as allow aviators more flexibility within training systems. The increased fidelity of the training will also help aviators more effectively learn about parachute descent procedures, which are important survival procedures.

STATUS

This SBIR underwent a competitive source selection to award Phase I contracts, during which four contractors conducted feasibility analyses and designed/developed prototypes. Based on progress made during Phase I and technical feasibility of Phase II designs, the evaluation team recommended a gated Phase II award for two vendors to continue design and development efforts. Resulting prototypes from Phase II base efforts were delivered and demonstrated to personnel within the Naval Survival Training Institute. A single vendor will continue design and development efforts during FY19-FY20, working to deliver a comprehensive, reconfigurable prototype for evaluation.

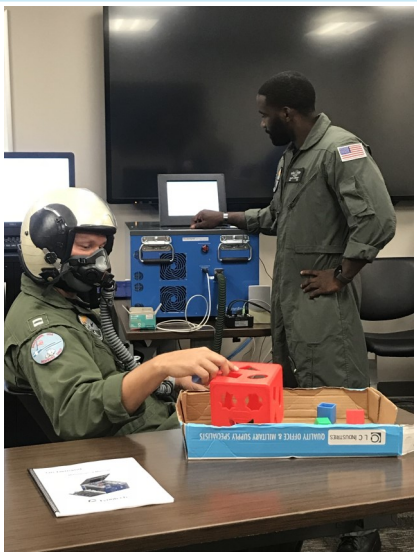
MILESTONES

- Phase I:
  - Kickoff meetings were held with each of the four Phase I contractors, and contractors status was monitored via bi-monthly progress reports and periodic status updates
  - Closeout briefs were held with each of the contractors to discuss Phase I progress and Phase II plans
  - Phase I Option was awarded for two vendors
- Phase II:
  - Phase II gated efforts were awarded for two vendors, resulting in a demonstration prototype
  - Phase II base period resulted in selection of a single Phase II vendor for the option period, with expansion funding

RESEARCH TO ADVANCE THE ON-DEMAND HYPOXIA TRAINIER FOR SURVIVAL TRAINING

OBJECTIVE

The effort seeks to continue research and development of a next generation hypoxia-training device. The goals of this research include analysis of average flow rate requirements, impacts of oxygen concentration on recovery, and continued development to enhance the system effectiveness and reliability.



Engineering testing of On-Demand Hypoxia Trainer with Aerospace Physiologists at NAS Pensacola to validate pressure on demand and initial training profile for hypoxia training.

PROJECT DURATION

MAR 2018- MAR 2020

FUNDING SPONSOR

PMA-205 | DHA

POINTS OF CONTACT

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DESCRIPTION

This effort seeks to empirically evaluate research questions about the On-Demand Hypoxia Training (ODHT) including: 1) the impact of variable oxygen concentration on recovery rates, 2) the effect of variable flow rates on breathing and experience of hypoxia symptoms, and 3) development to refine the product based on iterative fleet validation testing. Finally, this effort will investigate parallels that can be drawn between the cognitive decrements associated with alcohol intoxication and those associated with hypoxia.

BENEFITS

The acknowledged success of hypoxia training makes it paramount that the Navy ensures these capabilities remain available. In addition to providing a means for addressing the larger Navy research into mitigating hypoxia physiological episodes, this effort will advance the lab's understanding of hypoxia training. Further, this effort will provide the means to thoroughly investigate a novel technology to determine the effectiveness and efficiency of the devices to deliver higher fidelity training opportunities.

NEED

Hypoxia continues to remain a highly visible safety issue, with training being a significant part of the mitigation process. An ODHT prototype technology has been developed to overcome . However, in order to ensure a successful transition of the OHDT, additional research is necessary. These proposed studies will provide results that are essential to inform the design, establish standard operating procedures, and validate the effectiveness and reliability of a novel prototype hypoxia trainer prior to procurement.

STATUS

The team has completed preliminary research design and submitted the protocol to the Institutional Review Board for approval to collect data. Efforts have been underway to refine the design and development of the system regulator and other subassemblies based on fleet validation testing, resulting in identification of some modifications to increase breathing system fidelity on the device.

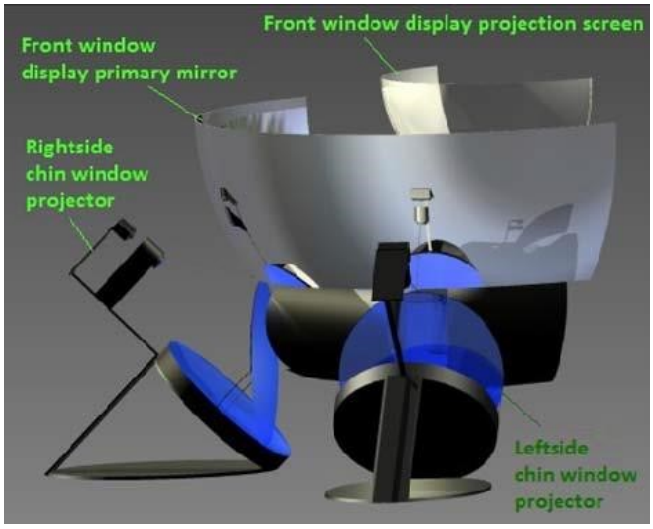
MILESTONES

- Presentations: Atkinson, Entinger, Tindall, Gilg, Scripture, Immeker, McEttrick, Sciarini, & Murr, (2018). A preliminary look at hypoxia compared to alcohol intoxication. Poster presented at AsMA 2018-Dallas, TX.
- Workforce Development: Mentored junior teammates on program management, data collection and analysis, and coordination with fleet customers.
- Transitions: Based on data collected at Miramar, CA and Pensacola, FL the team has designed and developed alternative human machine interface options and refined the subassembly design to increase the fidelity of the pressure-on-demand airflow ahead of procurement of a training device. PMA-205 plans to procure devices in late FY19 with fielding continuing into FY20. Results of additional human testing research will refine the Standard Operating Procedures for the aviation survival training location.

SMALL PROJECTOR ARRAY DISPLAY SYSTEM

OBJECTIVE

To produce an optical blinder system for Out-The-Window display systems that utilize stacked projectors in the vertical and horizontal direction that can be remotely tuned for night and NVG scenes. Visual display systems in this configuration have very limited access for tuning the optical blinder system.



3D model of display integrated in flight simulator with external housing omitted. Diagram courtesy of Holochip Corporation.

PROJECT DURATION

FEB 2017 - SEPT 2018

FUNDING SPONSOR

Naval Air Systems Command (NAVAIR)

POINTS OF CONTACT

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DESCRIPTION

Under this project, new concepts, algorithms, and devices will be researched to produce an optical blinder design which limits required personnel access to these devices during night and NVG edge blend display tuning. Methods such as remote edge shape control, precision measurement using auto-alignment capabilities, automated edge material construction (3D printing on CNC-like material cutting) will be explored to develop a process that creates accurate blinder edge shapes with minimized projector platform access.

NEED

Current blinder methods use fixed edge shapes with a single direction of motion, often requiring 'hand-tuning' of each edge shape in the projection system by accessing the projection frustum, inserting blinding material, estimating the shape, cutting the estimated shape, attaching that cut edge to the blinder assembly, and then adjusting the position using remote software. This can be tedious, iterative, and require several iterations of access to the projector assembly with the attached blinders.

BENEFITS

The benefits of this approach are faster setup and higher scene quality blending of projectors for night and NVG scenes used for training task such as pilot training, aerial gunnery, external lift operations, combat scenarios, standard and emergency flight procedures, hoist operations and crew coordination in simulated day or night all-weather conditions. This approach will reduce down time when projectors have to be replaced and allow for tuning the blending of projectors remotely.

STATUS

The Enhancement is a new FY17 effort that will build on the original SBIR Phase II design of a 2 axis projector blinder plate design.

MILESTONES

- The contractor has designed and tested several blender plate prototypes of different materials and ways to manufacture on site.
- The initial mechanical design has been completed and ready for building.
  - ◊ The electronics design and module selection has been completed.
- The software selection for embedded operating system for the controller has been determined; the software design has been completed and is now in development.
- For the original Phase II the contractor demonstrated prototype and delivered Phase II Final Report. (Sep 15).

TRANSITION OF A PRESSURE ON-DEMAND NORMOBARIC HYPOXIA TRAINING DEVICE FOR SURVIVAL SCHOOLHOUSES

OBJECTIVE

The effort seeks to support the technology transition of a next generation hypoxia-training device under development. The goals of this research include analysis of logistical concerns, human factors evaluations, and human testing to validate the fidelity and effectiveness.

Engineering testing of On-Demand Hypoxia Trainer with Aerospace Physiologists at NAS Pensacola to validate pressure on demand and initial training profile for hypoxia training.

PROJECT DURATION

OCT 2017 - SEP 2019

FUNDING SPONSOR

Naval Air Systems Command (NAVAIR) | Section 219

POINTS OF CONTACT

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DESCRIPTION

This effort will conduct the research and development efforts necessary for validating the fidelity, safety and concept of operations of the On-Demand Hypoxia Training Device under development for transition to PMA-205. In addition to the required research, we intend to conduct separate independent tests and evaluations to document the performance parameters and benefits of the novel technology for existing and potential acquisition communities. Specific tasks include: research and analysis of logistic requirements for training technology; conduct Human Factors Evaluation of the instructor console; conduct human testing with a military aviator population; and validation of training system.

NEED

As hypoxia continues to remain a highly visible safety issue, focus on a range of potential mitigation solutions is imperative. While a variety of engineering solutions aimed at the aircraft are being considered and tested, the final line of defense will remain in the hands of our trainers.

BENEFITS

The acknowledged success of hypoxia training makes it paramount that the Navy ensures these capabilities remain available. In addition to providing a means for addressing the larger Navy research into mitigating hypoxia physiological episodes, this effort will advance the lab's understanding of hypoxia training. Through usability analyses, researchers will document ways to increase the ease of use of the instructional capability. Further, this effort will provide the means to thoroughly investigate a novel technology to determine the effectiveness and efficiency of the devices to deliver higher fidelity training opportunities.

STATUS

First year tasking in FY18 focused on researching logistic requirements, conducting human factors evaluations of the prototype instructor console, and preliminary engineering testing with a military population. FY19 will focus on completing data collection, analysis and reporting.

MILESTONES

- Manuscripts/Publications: Published: B. Atkinson, Reeh, Zbranek, Balasubramanian, McEttrick, Immeker, Scheeler, (2017, November 30). Increased system fidelity for navy aviation hypoxia training. Proceedings of the 2017 I/ITSEC.
- Presentations: B. Atkinson, (2018, May 09). Aircrew self-report of physiological episodes: Lessons learned & the road ahead. Poster presented at AsMA 2018-Dallas, TX.
- Workforce Development: Mentored junior teammates on program management, interaction for transition, engineering and usability analyses, and coordination with fleet customers.
- Awards: B. Atkinson, (2018, January 15). Naval Aerospace & Operational Physiology Special Recognition Award.
- Transitions: In anticipation of transition in FY19, engineering testing was conducted at multiple fleet sites. Data was collected at Miramar, CA on the usability of the human machine interface and preliminary design, including pressure on demand breathing testing. Data was collected at Pensacola, FL to refine the pressure on demand breathing capability and test hypoxia training profiles with a military population.

CYBERSPACE OPERATIONS DEGRADED EXERCISE & SYNTHETIC TRAINING ARCHITECTURE (CODESTAR)

OBJECTIVE

Design, develop and demonstrate an architecture and cyber threat simulation software that can safely, securely, and realistically degrade critical surface warfare capabilities in support of Fleet mission assurance and Continuity of Operations (COOP) training requirements.

PROJECT DURATION
JUN 2017 - MAY 2018

FUNDING SPONSOR
Office of Naval Research (ONR)

POINT OF CONTACT
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DESCRIPTION

- Develop a concept, preliminary architecture, and cyber threat simulation software to safely, securely, and realistically incorporate degraded and denied conditions into Fleet synthetic training events.
- Detail which Navy training architectures, standards, models and simulations, and interfaces need to be updated to include Degraded Synthetic Training (DST) effects representations.
- Develop a detailed DST prototype that is compatible with training architectures and standards.

NEED

Cyber training ranges operate independently from the traditional M&S environments used to conduct battle staff and Fleet Synthetic Training (FST). Capabilities are needed at the tactical level to provide fleet surface warfare operators and leaders the opportunity to develop and practice Concepts of Operations (CONOPS) and Tactics, Techniques, and Procedures (TTP) for "fighting through" degraded and denied conditions.

BENEFITS

CODESTAR will extend an existing Degraded Synthetic Training Architecture with intelligent scenario adaptation tools. These tools will reduce the workload of instructors, training officers and exercise controllers through an interface console, while ensuring delivery of a high-quality experience to learners.

STATUS

This effort is an FY18 new start.

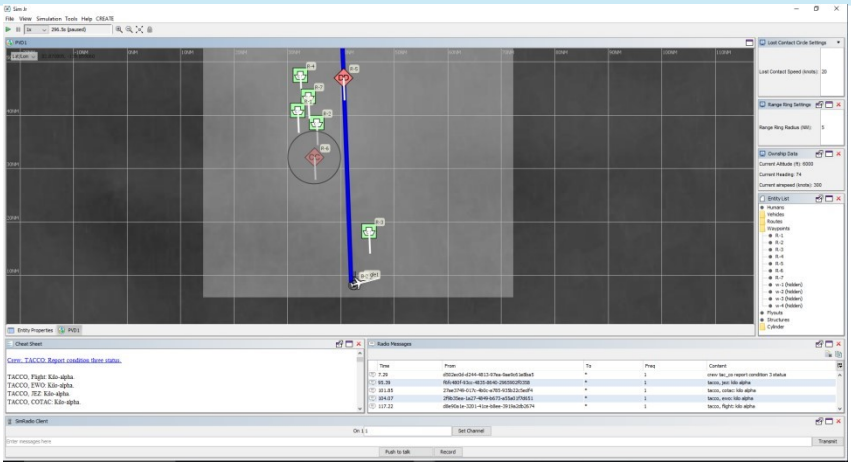
MILESTONES

- Define training requirements and extensions to the architecture
- Develop agent-based cyberspace training executive agent
- Design and implement a cyberspace management console

CREW ROLE-PLAYER ENABLED BY AUTOMATED TECHNOLOGY ENHANCEMENTS (CREATE)

OBJECTIVE

Develop a software application/ suite that provides a synthetic crew role player to support complex crewmember interactions during dynamic training events.



Prototype user interface for scenario management and tracking speech capability recognition and generation results

PROJECT DURATION

OCT 2014 - SEP 2020

FUNDING SPONSOR

Naval Air Systems Command (NAVAIR)

POINTS OF CONTACT

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DESCRIPTION

This effort seeks to design and develop a software application/ suite that provides a synthetic role-playing capability that will serve to enhance the training pipeline and potentially avoid costs and provide value added without the use of training aids. The required technology solution must integrate speech capabilities (i.e., recognition, understanding, synthesis), Subject Matter Expert level tactical domain information, reaction to multitasking and high stress situations, and relay of information via means other than speech communication (e.g., software inputs), are required.

NEED

Current Navy crew training requires the assembly of an entire crew or the use of Subject Matter Experts to support crew training. While training benefits from the additional costs associated with bringing a full crew together, some individual training could benefit from the added realism provided by crew interaction. During these events, the emphasis is on the crew member's individual skills; however, many tasks associated with their role may rely on inputs from other crew members.

BENEFITS

CREATE will enhance the training pipeline by streamlining the instructor's efforts during training. This will also add to the potential cost avoidance and provide value added without the use of training aids. Instructors will be able to manage more trainees at once in a more efficient manner, and be able to deliver more tailored instruction and feedback if necessary, increasing the quality of training.

STATUS

During Phase 2 and 2.5 efforts, the government worked with the contractor and transition customers to continue component research and development. Throughout this period, periodic demonstrations were conducted to the P-8A Fleet Project Team. Expansion efforts under the Phase II involved initial integration efforts with Boeing and NGTS, which were expanded upon during Phase II.5 efforts. The team works to continuously improve the speech recognition capabilities of the technology. A planned Phase 3 (FY19-20) will focus on implementation and testing within the P-8A part-task trainer, as well as further speech recognition hardening and testing.

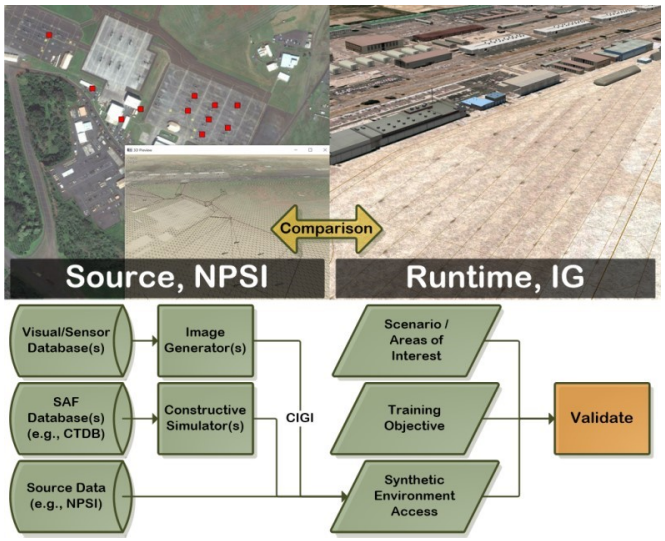
MILESTONES

- Phase I: Kickoff meetings were held with each of the three Phase I contractors, and contractors status was monitored via bi-monthly progress reports and periodic status updates; Closeout briefs were held with each of the contractors
- Phase II:
  - Phase II contract was awarded, resulting in a demonstration prototype
  - Phase II base period resulted in selection of a single Phase II vendor for the option period, with expansion funding
  - Phase II.5 contract awarded March of 2017, based on Technology Transition Agreement from PMA-205 and PMA-290
- Manuscripts/Publications: Atkinson, B. F. W., Killilea, J. P., Stensrud, B., Marinier, B., Schermerhorn, P., Dettmering, C., Saadat, S., & Anania, E. C. (2017). *Crew role-players enabled by automated technology enhancements.* Proceedings of the Interservice/ Industry Training Simulation & Education Conference, Orlando, FL.
- Presentations: Anania, E. C., Atkinson, B. F. W., & Killilea, J. (2017, October). *The application of automation systems for training - Implications of trust.* Presenting at the SAFE Symposium, Orlando, FL.

DISTRIBUTED SYNTHETIC ENVIRONMENT CORRELATION ARCHITECTURE AND METRICS

OBJECTIVE

Develop an innovative and extensible distributed synthetic environment correlation assessment architecture that can verify correlation between flight simulator visual and sensor databases.



The GameSim Validate tool is able to compare source data such as the NAVAIR Portable Source Initiative, semi-automated forces, and image generator runtime representations. Correlation between these representations takes into consideration not only the geometry and attributes but also scenario, areas of interest, and training objectives.

PROJECT DURATION

AUG 2015 - JAN 2018

FUNDING SPONSOR

Naval Air Systems Command (NAVAIR)

POINTS OF CONTACT

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DESCRIPTION

The aim of this study was to research and prototype a terrain database validation and correlation assessment system that works from both direct and indirect data sources, including NPSI dataset to NPSI dataset, NPSI dataset to runtime, and runtime to runtime comparisons. This SBIR will generate a flexible and expandable distributed synthetic environment correlation assessment architecture for aviation platforms that will be able to perform comparisons (correlation) between different formats, versions of the same visual databases, and the original geospatial source data.

NEED

Correlation assessments between terrain databases and interoperability of simulation models have been investigated over the years. However, a gap still exists in the automated assessments of correlation between large synthetic environments as far as it relates to visual and sensor simulation for U.S. Navy / Marine Corps flight simulators.

BENEFITS

The architecture will allow for the addition of new runtime and source formats, as well as new tests and analysis plug-in modules by third party developers. The correlation assessment is expected to put emphasis on aircraft mission areas of interest such as airports, landing zones, confined area landings, low-level terrain flight areas, and ranges. Furthermore, the correlation assessment will allow for the automated correlation assessment of designated areas of interest that affect mission performance, such as avenues of approach, key landmarks, feature densities and texture densities.

STATUS

GameSim has developed a framework, called Validate, to detect synthetic environment correlation and integrity errors realized in military training systems. Validate provides a means to test correlation between any combination of source datasets, such as the NAVAIR Portable Source Initiative (NPSI) and run-time image generation systems (IG). Implemented tests to date include; terrain elevation, elevation gap, slope, feature presence, feature placement, imagery resolution, and material comparison.

MILESTONES

- GameSim has tested these correlation tests between NPSI data sets provided by NAWCTSD (Source-to-Source) and between Rockwell Collins, Diamond Visionics and Aechelon image generators (Source-to-Runtime, and Runtime-to-Runtime).
- Publications
  - Joseph, J., Graniela, B. (2015). Terrain database fit-for-use correlation indicators. IMAGE Conference
  - Joseph, J., Graniela, B. (2015). Automated Runtime Terrain Database Correlation Assessment. The Interservice/ Industry Training, Simulation & Education Conference (I/ITSEC), Orlando FL.

DISTRIBUTED TRAINING NETWORK GUARD (DTNG)

OBJECTIVE

Develop a controlled interface that allows for extension and enhancements in a cost effective, short time period. The DTNG controlled interface operates between two simulation network security enclaves of differing administrative domains having the same security classification. The DTNG enforces security policies and controls the flow of information between these domains via a filtering rule set that pass, fail, or sanitize the training simulation data.

DTNG Logo

PROJECT DURATION

OCT 2016 - SEPT 2019

FUNDING SPONSOR

Naval Aviation Training Systems Program Office (Program Management Activity [PMA] 205) |
Joint Strike Fighter (JSF)

POINTS OF CONTACT

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DESCRIPTION

The DTNG provides a capability to label, segregate, protect, and exchange data between two interconnected simulation networks operating at the same classification level. This capability is designed to meet the data format and near real-time performance requirements of distributed training exercises.

As a controlled interface, the fundamental security requirements for the DTNG are to (a) protect classified information appropriately, (b) protect information from malicious or accidental tampering, loss, and destruction, (c) protect the DTNG system from foreseeable denial of service conditions, and (d) manage changes affecting the security of the DTNG.

NEED

Distributed training environments are in need of a controlled interface that enables training system connectivity with the ability to process multiple live, virtual and constructive (LVC) protocols, offering protection of program-specific "need-to-know" data from one or more of the participating training systems.

BENEFITS

The DTNG allows the various aviation platforms such as F/A-18, JSF, and E-2D to train in LVC environments with coalition partners while protecting sensitive information. Aviation platforms will no longer be limited to Training and Readiness (T&R) checks at the lowest required level of classification, and will greatly increase the efficiency and usage of training systems. Aviation platforms will also no longer need to hold separate, standalone events to conduct their higher classification specific, protected data training– allowing more Navy crews to train together and increase the number of T&R opportunities.

STATUS

DTNG was developed in the Interoperability, Design, Engineering & Application (IDEA) lab. The first DTNG system was deployed in the Navy Aviation Distributed Training Center (NADTC) at NAS Oceana in May 2017. Additional DTNG systems are planned for deployment to the NADTC in the second quarter of FY-19 to support other Navy aviation platforms. The DTNG supports the Distributed Interactive Simulation (DIS) v6 simulation protocol, while maintaining interoperability with High Level Architecture (HLA) simulation protocols with the use of the Joint Simulation Bus (JBUS) gateway. Native HLA 1.3 and HLA 1516e interfaces are in development.

MILESTONES

- DTNG v3.1.3 baseline received Interim Authority to Test (IATT) to support F-18 C/D training in May 2017 with Authorization to Operate (ATO) pending NADTC ATO approval.
- DTNG v3.1.3 baseline installed in the NADTC, NAS Oceana in May 2017.
- Funding received to develop and integrate simulation protocol adapters to support JSF training (Navy, United States Marine Corps [USMC], and UK) - July, 2017.
- Funding received to develop operational filtering rule set to support F-18 C/D training in FY-18.
- DTNG 3.1.0 baseline completed and submitted for ATO approval to support F-18 C/D training system. (December 2016)

ENVIRONMENT DESIGNED TO UNDERTAKE COUNTER A2AD TACTICS TRAINING & EXPERIMENTATION (EDUCAT2E)

OBJECTIVE

The current effort will participate in analyses, definition and development of human performance measures, standards and interfaces for use in the Navy Continuous Training Environment (NCTE), and in the development of constructive models. Live, Virtual and Constructive (LVC) demonstrations are planned throughout the effort to display technologies and capabilities and gain subject matter expert feedback.

Participants in Fleet Synthetic Training Research, Development, Test & Evaluation event

PROJECT DURATION

OCT 2014 - SEP 2018

FUNDING SPONSOR

Office of Naval Research (ONR)

POINT OF CONTACT

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DESCRIPTION

This S&T effort has two primary objectives:

1) Conduct analysis of multiplatform Electronic Warfare (EW) and Air Defense teams to understand how EW supports Air Defense & define roles/responsibilities, interdependencies, and multiplatform performance metrics
2) Define and develop synthetic, scenario based, distributed EW capabilities for Strike Group Electronic Warfare and Air Defense teams that can be used for both training and experimentation.

Outputs of this effort will support development of shore-based training technologies enabling training opportunities linked to both Basic and Intermediate Phase certification exercises.

NEED

Shore-based training events often lack inclusion of Information Warfare techniques preventing adequate exposure & integration within the Carrier Strike Group (CSG) prior to deployment certification. Thus, CSGs need training on all aspects of Information Warfare including Command & Control in Denied & Degraded Environments during both Basic & Intermediate training phases to effective CSG integration during deployment.

BENEFITS

This enabling capability will advance Fleet operational proficiency and readiness in sensing and characterizing EMS activity to enable adaptation and freedom of maneuver in the EMS as a means to effectively operate in C2D2E at the individual, unit and Composite Warfare Commanders levels.

STATUS

The team is finalizing the Cognitive Task Analysis (CTA) to send to stakeholders and planning a workshop to validate paper-based measures of trainee evaluations with EW/IO subject matter experts (SMEs) at Tactical Training Group Atlantic (TTGL). The team will also participate in a tactical demonstration to showcase the capabilities within the Joint After Action Review-Resource Library (JAAR-RL) tool during a Fleet Synthetic Training (FST) like event and conduct experimentation.

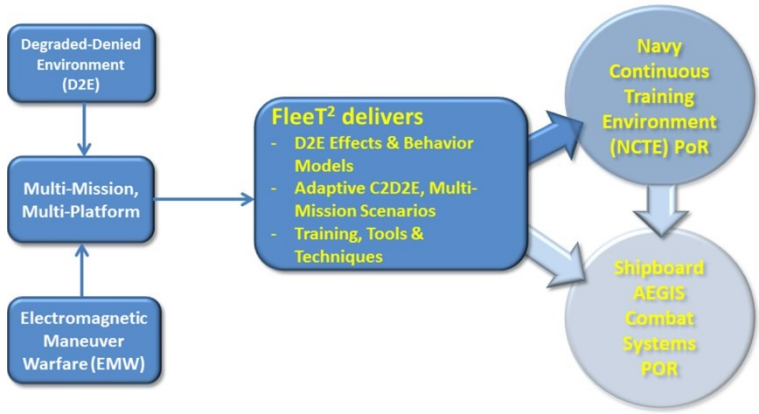
MILESTONES

- Participated in the Fleet Synthetic Training - Research, Development, Test, and Evaluation (FST RDT&E) 18-1 event involving novel LVC training capabilities to exercise cross platform/multiteam interactions for electronic warfare teams.
- Completed data collection with EW/IO instructor SMEs (MAR 2017)
  - Interviewed SMEs on both individual and team tasking, procedures, communication, and training
  - Identified training gaps (APR 2017)
  - Created task lists for EW personnel across surface and aviation platforms (APR2017)
- Authored a draft cognitive task analysis (CTA; SEP 2017)
- Created paper based measures for evaluating trainees during scenarios (SEP 2017)

FLEET TRAINING TECHNOLOGIES (FLEET2)

OBJECTIVE

Currently, the Navy plans and trains for pristine Command and Control (C2) environments. While C2 is by itself complex, the emergence of peer threats makes it even more difficult to ensure resilient C2 processes. In a Denied/Degraded Environment (D2E), adversaries may deploy a variety of tactics that create a dynamic environment, rife with additional challenges. Training in the absence of these realities presents a threat to effective C2–a critical component of naval surface operations. FleeT2 will provide new training approaches and technologies.



PROJECT DURATION

OCT 2017 - OCT 2022

FUNDING SPONSOR

Office of Naval Research (ONR)

POINTS OF CONTACT

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DESCRIPTION

FleeT2 is designed to allow trainers to build scalable phenomenology models and virtual assets to simulate, test, and train to emergent threats and technologies. The virtual constructive simulation capabilities planned for Fleet2 will allow the system to produce accurate, detailed, threat-dense, and intense scenarios that would be cost prohibitive or otherwise impossible to perform in the real world. Synthetic models can be easily modified, repeated, and adapted to train various situations, user roles, and skill levels. Ultimately, Fleet2 will allow command teams and system operators to train for integrated, cross-platform warfare against simulated peer threats with counter D2 capabilities.

NEED

Naval surface Command and Control (C2) is a broad domain encompassing the management of coordinated electronic surveillance, information integration across enterprise sensors and information sources, and personnel/asset management in support of missions. Understanding all the demands facing C2 performers is further complicated by the fact that C2 personnel operate at many echelons of command and across many specialized functional areas. Creating the training systems and curricula necessary to support such a domain will be challenging.

BENEFITS

There are two anticipated benefits arising from the FleeT2 program. First, the fleet will have a secure environment to train to address Denied/Degraded Environment (D2E) threats. Further, the simulations will be extensible to evolving and emerging threats. Second, the fleet will be able to train for D2E operations more effectively at a lower cost. This should result in a reduction in underway deployments required for training while providing an environment that mirrors the real world.

STATUS

FleeT2 is a new start Pre-Future Naval Capability effort. In FY18 a task analysis will be conducted for the Warfare Commanders to define concepts of operation in D2E, a preliminary set of performance measures for these teams, and a set of human computer interface mockups to support development of training tools.

MILESTONES

- A Technology Transition Agreement was signed between the Office of Naval Research (Code 341), OPNAV N96 (Director, Manpower and Training), Fleet Forces Command (N72), Program Executive Office Integrated Warfare Systems Integrated Training (1IT), and the Navy Continuous Training Environment, NSWC Corona (RS20F).

INTEGRATED WARFIGHTING CAPABILITIES (IWC) FIDELITY INVESTIGATION

OBJECTIVE

This effort seeks to identify the impacts of physical fidelity on proficiency. Specifically, this effort will investigate the level of physical fidelity required to train various Naval Integrated Fire Control - Counter Air (NIFC-CA) specific tasks and skills identified by the PMA-205 funded Front End Analysis (FEA). Findings from this effort will provide empirical data to inform training requirements, as well as preliminary findings to understand the perishability.

PROJECT DURATION

OCT 2017- SEP 2019

FUNDING SPONSOR

Naval Air Systems Command (NAVAIR) | Section 219

POINTS OF CONTACT

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DESCRIPTION

This effort consists of a three pronged approach to experimentation. First, a simulator analysis will be conducted. Analysis will include current Fleet training capabilities for high and low fidelity simulators will be conducted to ensure current Fleet capabilities can be appropriately replicated in the lab; and experimental assets that can replicate these capabilities as closely as possible. Next, development efforts will enhance any models that may be lacking in the selected assets. Finally, experimentation will be conducted to understand the impact of high and low physical fidelity when functional fidelity and instructional strategy are held constant.

NEED

Fleet training communities have begun to stand-up low fidelity training facilities (e.g., Air Defense Strike Group Facility [ADSGF], Fallon) to mitigate the maturity levels and issues associated with distributed SoS training. However, little research has been done to understand the impact these low fidelity devices will have on Training and Readiness (T&R) credit. This effort specifically seeks to address this need by identifying the impacts of physical fidelity on proficiency at multiple levels of the Strike Group using VC training.

BENEFITS

Findings will provide an understanding of the types of training objectives that can effectively be acquired using varying levels of physical fidelity. These findings can be applied to the broader IWC domain and to Live, Virtual, and Constructive training to provide insight on training system fidelity requirements. Additionally, this effort will provide empirical data associated with quantifying the amount of training required to acquire and maintain IWC skills in terms of learning and decay rates to better inform T&R and proficiency requirements.

STATUS

Analysis of current simulation capabilities both Fleet training and experimentation has been completed and experimental assets identified. Enhancements to ownship weapons model for the high fidelity simulator at Manned Flight Simulator have been verified and validated with Fleet Subject Matter Experts (SMEs). Scenarios and measures have been developed and also verified and validated with Fleet SMEs. Experiment set to take place in FY19.

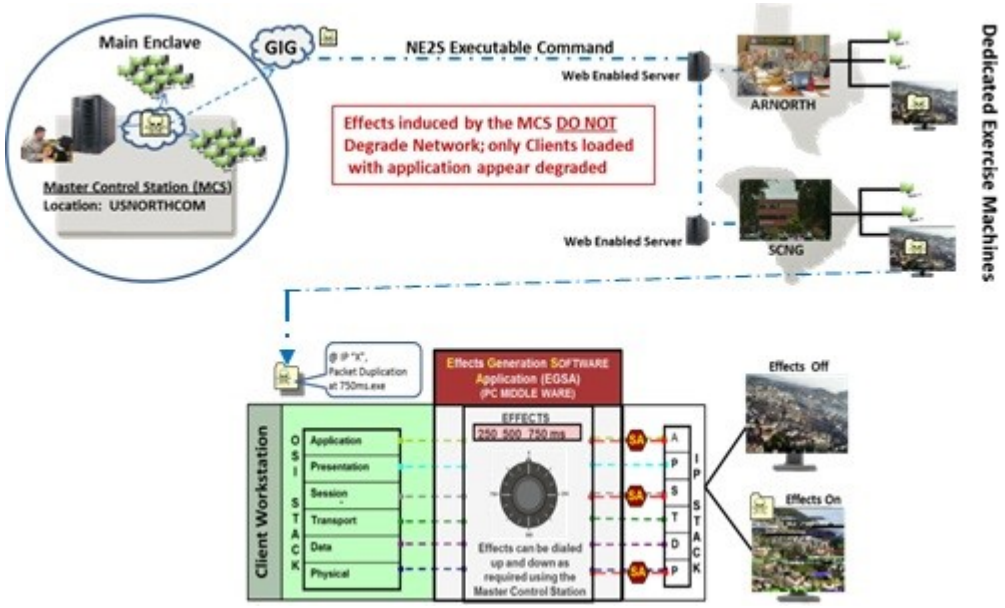
MILESTONES

- Observations of training conducted at Advanced Strike Group Facility completed (FY17)
- Analysis of training systems report in prepared (FY18)
- Weapons model development, scenarios, and measures validated and verified with Fleet SMEs (FY18)
- Pilot testing and experimentation set to take place FY19

NETWORK EFFECTS EMULATION SYSTEM (NE2S)

OBJECTIVE

The objective of this project is to research and develop a cost effective, enterprise tool for the Net-Centric Systems Test (NST) and training and experimentation communities capable of simulating a wide range of network and host based effects that can be centrally managed and controlled.



PROJECT DURATION

SEP 2014 - SEP 2018

FUNDING SPONSOR

Naval Aviation Training Systems Program Office (Program Management Activity [PMA] 205)

POINTS OF CONTACT

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DESCRIPTION

The NE2S software provides support to various distributed sites and terminal/systems. By emulating network and host based effects, NE2S enables the Testing, Training and Experimentation communities to create a wide range of conditions under which people, applications and systems can be tested (i.e., Cyber for Cyber) improving event reality. NE2S provides realistic training capability during events or exercises whether local or distributed.

BENEFITS

NE2S provides realistic emulation of network and host-based cyberspace effects. NE2S integrates traditional test and training environments with cyber-attack scenarios. The Master Control Station (MCS) affords centralized control of real time, instructor-initiated effects, or scripted scheduled scenarios. NE2S employs a network-centric architecture and currently supports Linux and Windows operating systems.

NEED

The Test and Evaluation (T&E)/Science and Technology (S&T) Net-Centric Systems Test (NST) program exploits new technologies and processes to meet important T&E requirements; expedites the transition of new technologies from the laboratory environment to the T&E community; and leverages commercial equipment, modeling and simulation, and networking innovations to support T&E.

STATUS

This project will be utilized in several military events and exercises in the upcoming future at U.S. Indo-Pacific Command and its Components and partners. More software upgrades and improvements are planned for the next year. Achievement of a Risk Management Framework Authority to Operate is also expected.

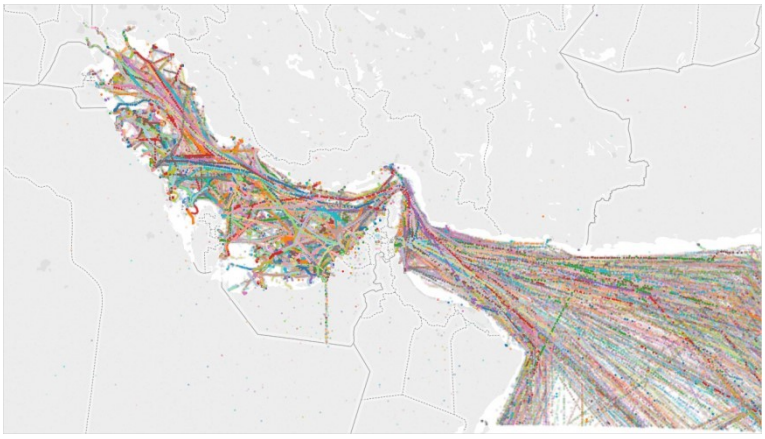
MILESTONES

- A NE2S prototype system is being used in daily operations for the U.S Army Training and Doctrine Command (TRADOC) Training Brain Repository, as well as the South Carolina National Guard and Army.
- Over the past year, the focus was on working on software upgrades.
  - Improved NE2S client application stability and reliability
  - Improved NE2S Master Control Station installation and deployment processes
  - Added phishing effect including ability to "chain" effects based on end user actions and threat vectors
  - Added ransomware effect
  - Created build mechanism to make the NE2S suite available as a DVD or .iso to deploy on-premise or cloud
  - Initiated RMF process for an NE2S application ATO
  - Migrated from Joint Training Data Services (JTDS) to Defense Intelligence Information Enterprise (DI2E) environment to provide enhanced collaborative development features and distribution

VERIFICATION AND VALIDATION OF HIGHER FIDELITY CONSTRUCTIVE ENTITIES FOR UAS TRAINING

OBJECTIVE

This research effort will (1) assess the impact of using live data within the Next Generation Threat System (NGTS) to improve training realism and fidelity of constructive entities and to verify the gains in training effectiveness and efficiency that result for UAS operators and Naval Aviators and (2) create a controlled training effectiveness evaluation (TEE) process that can be replicated and generalized to component trainers across domains.



Raw input data reflecting real-world, white shipping behavior. This data helps to quickly populate scenarios, reducing operator workload.

PROJECT DURATION

OCT 2017 - SEP 2020

FUNDING SPONSOR

Naval Air Systems Command (NAVAIR) | Section 219

POINTS OF CONTACT

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DESCRIPTION

Utilizing science of learning research principles, we will empirically evaluate the effects of higher fidelity training stimuli on performance. Using the Dynamic Adaptive and Modular Entities for UAS (DYADEM) capability, we will conduct a controlled experiment with the fleet to test our hypotheses (investigating trainee reactions, learning gains, and reported workload), collect quantitative/objective data, and create a method of assessing a capability meant to improve a training system without adding training content. Specifically, we wish to explore the effects of the new capability on performance, distinct from the NGTS training content.

NEED

Currently, the impact of the DYADEM capability on learning and performance has yet to be investigated or verified. This is due both to a lack of experimental control in applied/operational training settings as well as a lack of process or methodology that is needed to scientifically and systematically test the training effectiveness of technology that does not add additional training content but rather enhances current training fidelity.

BENEFITS

The impact of the proposed work will improve training not only for UAS but for P-8 and Triton, increase NGTS capabilities, inform training decisions, and predict what the impact will be on the fleet community as well as determining the return on investment for component training. The findings from this research will be used to drive future TEE studies to show value in Naval training capabilities. Additionally, this research offers guidance for LVC Test and Training to optimize individual and collective test and training capabilities through development, expansion, and refinement of live-virtual-constructive capabilities across test and training environments, learner populations, and across domains, systems, and security levels.

STATUS

In FY18 the team (1) interviewed instructors at NAS Jacksonville on current system capabilities and limitations (2) interviewed retired UAS training subject matter experts (SMEs) (3) analyzed interview data and (4) worked with SMEs and engineers on testbed modifications to capture performance and workload data.

MILESTONES

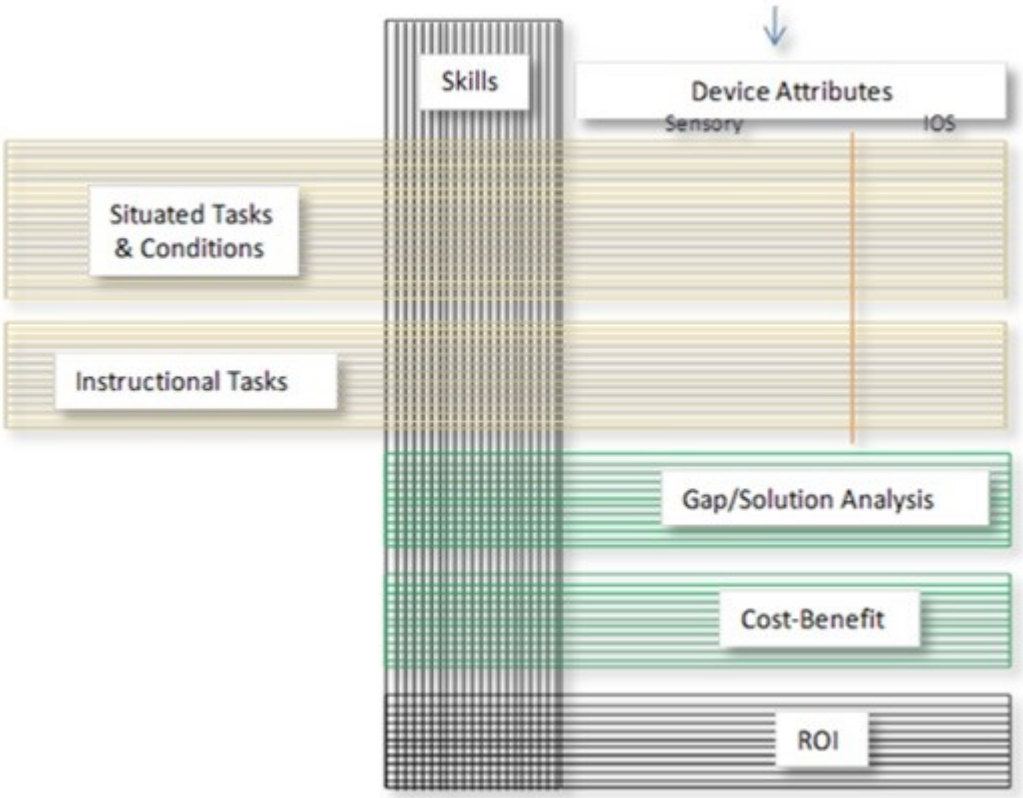
- Completed qualitative SME data collection (JAN18)
- Completed experimental design (JUL18)
- Developed design recommendations for experimental testbed (AUG18)
- Pilot testing and experimentation to take place in FY19

CORE CAPABILITY 4:
HUMAN SYSTEMS ANALYSIS, DESIGN AND EVALUATION

AIR-4.6 supports and improves human performance through the analysis, design, evaluation, and acquisition of cost-effective training solutions that are both responsive and proven to meet learning, performance, and readiness requirements. This capability is utilized across aviation, surface, undersea and cross warfare domains. Through the application of analytical methods, grounded design theories, and instructional design principles, analysts conceptualize, evaluate, and optimize the design and implementation of training systems and pipelines.

The following Technology areas comprise this Core Capability:

- High-Fidelity Training Environments
- Courseware Design
- Training Optimization Analysis
- Training Effectiveness Evaluation (TEE)



MULTI-MEDIA KNOWLEDGE CAPTURE (MKC) ENGINE

OBJECTIVE

Authoring tool for creating multi-media presentations & video locally that can be shared within & across the Navy enterprise in a timely & efficient manner to allow warfighters to address the unique knowledge needs of warfighters on an as-needed/ where needed basis.

Basic Multi-media Knowledge Capture Engine cycle of warfighter identifying a need to share tacit knowledge, inputting the information into the system in predetermined template, and distributing it over a Wide Area Network.

PROJECT DURATION
OCT 2017 - SEP 2020

FUNDING SPONSOR
Office of Naval Research

POINTS OF CONTACT
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DESCRIPTION

Existing approaches for creating learning materials to support fleet operational needs are ad hoc and not responsive to current fleet information share needs, nor do they reflect capabilities represented by a rapidly changing technology base. The current approach of creating formal training content is too slow and inflexible. Material generated often does not address the specific needs for local topical knowledge both ashore and aboard ship. A new approach is needed capture locally generated to serve the needs of warfighters across the Navy enterprise addressing a diverse range of subject matter. Solutions that empower sailors to train each other, supplementing formal training with experience and immediate requirements based knowledge are needed.

NEED

The Navy is seeking ways to more rapidly deliver timely, relevant information to Sailor and Marine warfighters. Much of the information that is most urgently needed resides as knowledge and expertise within their fellow warfighters. Tools that facilitate multi-media and key-word tagged content-creation are of interest. The authoring tools would not only facilitate the creation of content but would enable discovery and distribution of content.

BENEFITS

Sailors and Marines will be empowered to create and share relevant information as needed and where needed. This effort is responsive to the demands of Sailor 2025 and the Navy Ready Relevant Learning initiatives. This will enable sailor/warfighter driven content creation through an intuitive, wizard-driven capability.

STATUS

This effort was selected for award as a FY18 new start. Awards were made to three small businesses and a down-select is anticipated in the first quarter of FY19 with a Phase II award anticipated in the fourth quarter of FY19.

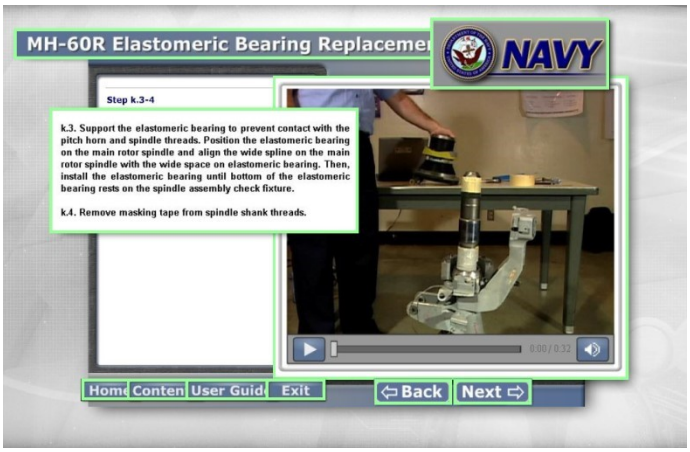
MILESTONES

- Awards were made to three small businesses for Phase I

UTILITY AND EFFECTIVENESS OF USING FLEET-PRODUCED MAINTENANCE VIDEOS AS JOB PERFORMANCE AIDS

OBJECTIVE

The objective of this proposal is to evaluate the utility and effectiveness of using Fleet produced maintenance videos as job performance aids (JPA) on complex maintenance tasks. An empirical study will be conducted to assess maintainer proficiency and satisfaction on a selected maintenance task utilizing a tablet-based Maintenance Ready Card with embedded video, compared to a control condition utilizing a tablet-based MRC without video.



Example of video as a Maintenance Job performance aid

PROJECT DURATION

OCT 2017 - SEP 2018

FUNDING SPONSOR

Naval Air Systems Command (NAVAIR) | Section 219

POINTS OF CONTACT

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DESCRIPTION

The proposed research effort will focus on the following primary activities:

1. Process and governance for Fleet produced video development and sharing
2. Guiding principles and best practices in instructional design and human factors for video creations and content development
3. Development of video content and experimental prototypes
4. Empirical evaluation of the impact of videos as JPA on maintenance task performance and utility considerations

NEED

Integrated Logistics Support (ILS) STO-2 calls for improved maintenance capabilities to address the increasing complexity and costs of maintaining aircraft systems. Further, technologies and tools are needed which enable the rapid integration of support equipment and maintenance practices through reduced maintainer workload and turnaround times.

BENEFITS

This project involves the development of a video generation process and guidelines to help provide the Fleet maintainer with visual aids to help with complex maintenance tasks. The video generation process currently does not exist and instances of unauthorized maintenance videos have been routinely emerging to help bridge a gap. This effort is attempting to curb that practice and put in place common sense practices for the creation of these videos that follow governance covering official validation and verification and configuration management processes.

STATUS

This project was started in October 2017 (start of FY18). Efforts to be completed by the end of FY18 will focus on 1) creation of video content and tablet-based prototypes for empirical study, 2) submission and approval of protocol by IRB, 3) execution of empirical study, and 4) development of video production guidelines.

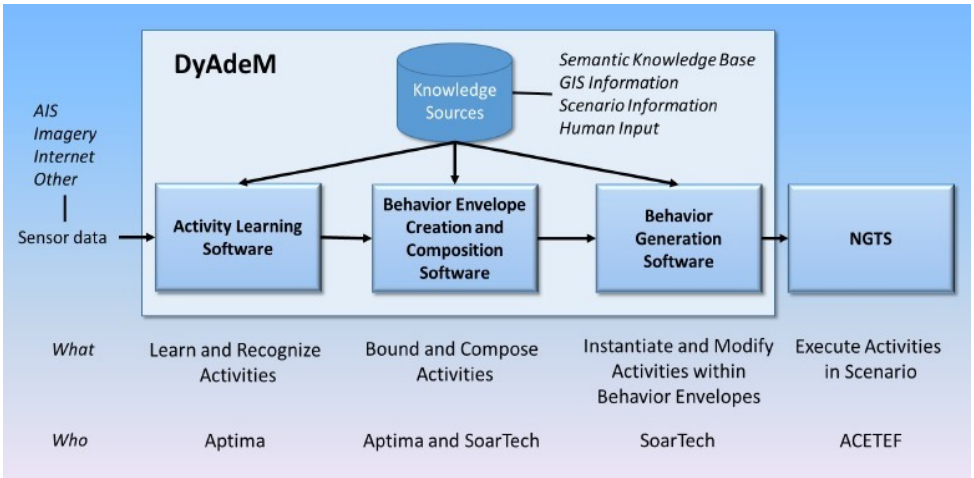
MILESTONES

- Final technical report to be published
- Video Template and How-To Manual for Fleet use to be developed
- Configuration Management Plan and Verification & Validation procedure for Video Content to be developed
- Tablet-based prototypes (with and without embedded videos) to be developed
- Mentoring of local NAWCTSD Entry-Level Employees (ELEs) on this project exposing them to Fleet maintenance tasks and analysis

DISTRIBUTED, ADAPTIVE, AND MODULAR ENTITIES FOR UNMANNED AERIAL SYSTEMS (DYADEM)

OBJECTIVE

The primary objective of the project is to enable realistic and increasingly intelligent white force activity in tactically plausible scenarios by developing, at appropriate scales, computer generated force (CGF) to act in them in realistic, complex, Patterns of Life (PoL). The long-term objective is that the CGF behaviors will be dynamic, allowing for tactically-realistic and contextually relevant performance that requires minimal operator guidance to develop, modify, and maintain.



PROJECT DURATION

MAR 2014 - MAR 2018

FUNDING SPONSOR

Office of Naval Research (ONR)

POINTS OF CONTACT

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DESCRIPTION

DyAdeM includes replacing hand-coded rule sets with a capability to automatically generate new and appropriate CGF behaviors from one or more data sources including: data captured during live UAS exercises; data captured from experts operating their systems within a simulated environment; or data provided in a script-like format. On final delivery, the DyAdeM product will deliver a software based content generation capability that converts "raw" data (captured during live exercises, recorded during actual missions or generated from live range testing) into realistic CGF behaviors that will populate training scenarios.

NEED

DyAdeM will deliver the tools, standards, and guidelines to generate large numbers of realistic semi-automated force (SAF) or computer generated force (CGF) behaviors in a format that can be integrated into the Navy's SAF generation technology, the Next Generation Threat System (NGTS). The primary requirement of this product is to aid the integration of hundreds, if not thousands, of simulated entities into the overall training scenario that aviation requires.

BENEFITS

DyAdeM will create more realistic patterns of life for entities within training scenarios, thus creating more realistic and effective training. It will also save time by reducing operator workload by using real world data to generate scenario content on the fly.

STATUS

DyAdeM is in the final year of the program. The team is working to acquire and analyze raw data, complete the deliverables, and run a verification and validation study looking at system effectiveness. Period of performance ends MAR2017.

MILESTONES

2017 Products

- Delivered a data package to ONR that included:
  - Realistic Pattern of Life waypoints
  - Software that generates NGTS Route Objects (NRoute) for use by entities at scenario start
  - Improved scenario start files
  - System that generates realistic, computationally simple Pattern of Life behavior specifications for distracter entities
- Interim Program Reviews (IPRs) and Technical Information Meetings (TIMs) FEB 2017 and AUG 2017

EFFECTIVENESS ASSESSMENTS OF MIXED & IMMERSIVE REALITY FOR AVIATION TRAINING

OBJECTIVE

To develop a methodology that results in a capability to investigate the training effectiveness, comparable utility, and return on investment of an augmented reality solution for applied training task.

Sample Augmented Reality headset used for testing toolkit

PROJECT DURATION

MAY 2015 - MAY 2018

FUNDING SPONSOR

Naval Air Systems Command (NAVAIR)

POINTS OF CONTACT

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DESCRIPTION

Augmented reality (AR) has been on the cusp of ushering in a training paradigm shift for over a decade by allowing overlays of a digital world on real platforms. Although the Navy and industry counterparts have been exploring the value of using AR technology in training, few rigorous measurements of effectiveness have been conducted of AR itself, as well as comparing it to other related training technologies. Yet, as technology improves, AR remains a promising training capability as it enables embedded "train as you fight" training. The Navy is seeking an analysis tool grounded in a methodology that supports comparison of AR and alternative solutions for a representative training environment.

NEED

The resulting tool will include development of generalizable, best-of-breed methodology that will allow researchers to quantify the effectiveness of modern AR training and how AR training performance compares to related technologies. This effort focuses on delivering a rigorous measurement of effectiveness of AR and ability to calculate return on investment or design solution tradeoffs of comparative technologies.

BENEFITS

The development of a tool that has the capability to measure the training effectiveness, comparable utility, and return on investment of an augmented reality solution for applied training task.

STATUS

During Phase I efforts, performers identified feasibility solutions and produced early rapid prototypes for AR and alternative training solutions (e.g., handheld tablet training, game-engine based virtual environment training) for aviation training. Performers started experimental design planning, including identification of applicable methods of assessing effectiveness, utility performance comparisons, and return on investment analyses as part of Phase II proposed efforts. Down-selection at the end of Phase I resulted in a single Phase II contract award early FY19.

MILESTONES

- Phase I:
  - Phase I progress monitoring was completed via bi-monthly progress reports and periodic status updates
  - Closeout briefs were held with each of the contractors to discuss Phase I progress and Phase II plans, at which time vendors demonstrated feasibility for the development of AR and alternative training solutions (e.g., mobile training application, game-engine based virtual environment (VR) training) for a representative training task
  - Phase I progress and initial Phase II proposals included experimental design plan, including identification of applicable methods of assessing effectiveness, utility performance comparisons, and return on investment analyses
- Phase II:
  - Phase II contract awarded to single vendor, with a capability demonstration of the AR, VR, and mobile training prototypes at I/ITSEC 2018

OCEANOGRAPHY TACTICS TRAINING FOR EMPLOYMENT READINESS

OBJECTIVE

Develop a software-based tool to rapidly generate web-based animated training content for employment of advanced oceanography tactics and is capable of incorporating adaptive content presentation based on learner progress through knowledge assessments.

TRITON Systems Inc., example of animated training scenario.

PROJECT DURATION

SEP 2018- SEP 2021

FUNDING SPONSORS

Naval Air Systems Command (NAVAIR)
Small Business Technology Transition (STTR)

POINTS OF CONTACT

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DESCRIPTION

The Navy's crawl-walk-run approach to aviation training provides learning opportunities through mixed media beginning with classroom lectures and computer-based training, engagement with equipment through individual and part task training, and finally aircrew training in high fidelity simulation-based or live environments. Early computer-based training focuses on very specific foundational skills and teaches them in a vacuum. To address this issue, the Navy advocates building a capability that allows instructors or Subject Matter Experts (SMEs) to easily build training scenarios that are immersive and interactive physics-based animations and models.

NEED

This effort addresses the unidimensionality of early computer-based training by providing opportunities for trainees to start combining and building upon skills. The goal is to increase the accessibility of remediation or advanced skill development training opportunities by providing instructors with tools to rapidly develop web-based training content that animates advanced oceanography tactical employment to provide learners with the opportunity to remediate challenging skills and/or increase their skill base. Additionally, the capability should allow instructors and SMEs to build in assessment and consider intelligent tutoring functionality to ensures trainees have a degree of mastery before moving forward.

BENEFITS

Navy leadership has called for technologies that help tp advance the Navy's crawl-walk-run approach to aviation training. This effort seeks to provide learning opportunities through mixed media beginning with classroom lectures and computer-based training, engagement with equipment through individual and part task training, and finally aircrew training in high fidelity simulation-based or live environments.

STATUS

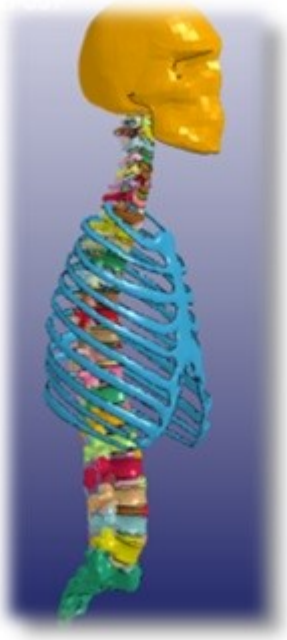
This SBIR topic was released for small business proposals to Phase I. The government technical evaluation team has completed review of 14 Phase I proposals. After an extensive review of Phase I proposals, three contractors were selected for award. Phase I contracts have been awarded and kickoff meetings are scheduled.

MILESTONES

- Phase I:
  - Proposals from 14 vendors were evaluated for technical approach, qualifications, and commercialization
  - Three contractors were selected for Phase I awards
  - Kickoff meetings are scheduled for early November

CORE CAPABILITY 5:
WARFIGHTER PROTECTION, PERFORMANCE, AND SURVIVABILITY

AIR-4.6 uses an underlying human-centered philosophy to enhance warfighter and maintainer protection, performance to reduce the risk of injury through the use of a systems approach for the development of protective ensembles, equipment and performance force multipliers. AIR-4.6 applies the principles of human systems integration to ensure that concept development addresses total system performance and the use of human engineering to ensure that both mission effectiveness and safety are key success criteria. For this discussion, "Protection" is defined as reduced vulnerability to all injury mechanisms; "Performance" includes skills that result in increased ability or lethality, and enhanced "Survivability" results in decreased combat casualties.



Warfighters endure a wide range of physical, cognitive, emotional, and physiological stressors during normal operations and even more so during missions and active combat. Stressors include long duration missions in extreme climates, hazardous noise, maneuvering and impact acceleration, vibration and shock forces, and frequent altitude changes. Combat injuries occur not only from kinetic threats leading to internal organ and musculoskeletal injuries, but risk mitigations are needed for health/safety hazards, e.g., drowning, burns, falls, chemical/biologic/ radiologic exposures, noise, and exposure to allergens. Historically, life support systems (LSS) development programs addressed these issues as largely independent challenges. When development was uncoordinated (lacking design agreement between supporting groups), the resulting LSS were often bulky, heavy, hot, and had adverse impacts on other human performance survivability factors, e.g., crashworthiness and/or ejection. Poor LSS design encumbers the warfighter, contributing to fatigue, distraction, and ultimately decreased mission performance/effectiveness. Furthermore, some LSS designs inflicted unintended adverse consequences, such as digital night vision goggles (NVG) and devices, as well as helmet mounted devices (HMD). These performance force multipliers clearly enhance mission performance but can result in neck, back pain, reduced cervical range of motion, and increased injury risk during aircraft ejection or crash. Modern seating systems perform their primary function well. However, the seats were designed for impact protection and do not necessarily provide ergonomic support to warfighters for extended 5+ hour operations. Lack of attention to ergonomics often contributes to chronic musculoskeletal pain and injury of Warfighters.

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CORE CAPABILITY 5:
WARFIGHTER PROTECTION, PERFORMANCE, AND SURVIVABILITY

Continued from previous page

Through a coordinated use of integrated casualty prediction modeling, development, and testing, AIR-4.6's human-centered LSS design became efficient and agile, thus enabling a rapid response to the dynamically changing needs of coalition and irregular warfare (IW) personnel. This integrated approach includes quantifying human responses to exposure to various combinations of environmental stresses; determining injury mechanisms; developing verified and validated computational, kinematic, and physical models to describe and predict the response to stressors and quantifying injury risk; exercising these modeling tools to provide design criteria for performance force multipliers; using advanced testing methodologies to develop design criteria that account for individual tolerance differences; and creating and validating mitigation technologies and strategies that both optimize performance and reduce risk.

Each project tackles stratified issues of sex, age, and anthropometric accommodation, so that all warfighters are optimized for combat and not just a select portion of the total population.

AIR-4.6's human-centered LSS goal is to furnish personnel with systems that maximize protection and enhance performance in the full spectrum of combat environments while minimizing chronic and traumatic injury. These transformational warfighting enhancements will enable warfighters to not only overcome environmental threats and respond to ever-expanding mission demands and platform capability growth, but to dominate in all dimensions of the battlespace environment.

The following Technology areas comprise this Core Capability:

- Determine Injury Mechanisms
- Develop Injury Prevention and Mitigation Technologies
- Ensure Warfighter and Support Personnel Accommodation
- Develop/Evaluate Electro-Optical (EO) Sensors, Displays, Interfaces and Devices
- Develop Equipment and Procedures Related to Aircraft LSS Performance, and Maintainability

CONSTRUCT CORRESPONDENCE OF PHYSIOLOGICAL AND SUBJECTIVE MEASURES OF HYPOXIA

OBJECTIVE

This project seeks to evaluate the relationship between extant physiological measures and subjective measures of hypoxia symptoms in order to better understand physiological hazard report data from aviators and improve hypoxia awareness and mitigation training.

Tedd Muery, center, a T-45 simulator instructor, and LCDR Thomas Jones, a physiologist from Chief of Naval Air Training, give dynamic hypoxia training to 1st Lt. Gregg Borman, a Marine student naval aviator assigned to Training Squadron (VT) 22. The hypoxia training involves a reduced oxygen breathing device which exposes aircrew to actual hypoxic conditions.

PROJECT DURATION

OCT 2016 - SEP 2018

FUNDING SPONSOR

Naval Air Systems Command (NAVAIR)

POINTS OF CONTACT

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DESCRIPTION

To evaluate the relationship between extant physiological measures and subjective measures of hypoxia symptoms in order to better understand physiological hazard report data from aviators and improve hypoxia awareness and mitigation training. The study will focus on collecting both subjective and physiological measures of hypoxia, as well as demographic data and individual difference factors to determine how these factors affect specific hypoxia criteria. Outcomes of this research can help us decipher which subjective measures of hypoxia are actually products of demographic and individual difference factors and which demographic and individual difference factors.

NEED

The proposed research has several key, direct benefits for NAWCTSD/NAVAIR, thrust areas and the NAE. Validation of subjective responses to hypoxia against physiological responses to enable better interpretation of HAZREP data and inform future surveys to capture reports. Facilitate a better understanding of individual difference/ demographic factors that influence susceptibility to subjective responses to hypoxia to inform training enhancements and inform potential predispositions in individuals.

BENEFITS

Understanding hypoxia, its symptoms, and how to effectively train aviators to recognize those symptoms will save lives. Hypoxia is a prevalent issue and is a key factor of aviation mishaps for Naval aviators. Understanding who experiences hypoxia and when will increase the fidelity of training as well as be a preventative safeguard against mishaps.

STATUS

Following approval of an Institutional Review Board protocol and letters approving recruitment at Navy training locations, a team of research psychologists and engineers developed a web-based application to capture symptom data from observers and students. Research psychologists performed observations of training events at Aviation Survival Training Center (ASTC) Pensacola, beginning with a pilot to refine the protocol. Using the refined application and protocol, data was collected data at three ASTCs resulting in data capture from 109 students. Preliminary results are available with final results becoming available in early FY19.

MILESTONES

- Presentations:
  - E. Anania, Dr. M. Tindall, B. Atkinson, (2017, October 31). *Investigation of Hypoxia Training: Do Trainees Accurately Recognize Symptoms*. Presented at SAFE Symposium, Orlando, FL.
  - T. Cooper, Dr. M. Tindall, B. Atkinson, (2017, October 31). *Manifestations of True Hypoxia: Drawing the Distinction between Real Symptoms and Symptoms that Mislead*. Presented at SAFE Symposium, Orlando, FL.
- Collaborative Mechanisms/Agreements:
  - Received letters from Chief of Naval Air Training (CNATRA) and Naval Medical Operational Training Center to recruit participants and conduct research with on-site Aerospace Physiologists.
  - Collaborating with Embry Riddle Aeronautics University (ERAU) for data collection, analysis and reporting
- Workforce Development: Mentored junior teammates and interns on data collection and analyses, as well as coordination with fleet customers.

FIREFIGHTING TRAINER MODIFICATION AND ENHANCEMENT

OBJECTIVE

The purpose of this effort is to mature and incorporate stress measurement technologies into the Surface Warfare Officers School (SWOS) 0418 Advanced Team Firefighting and Damage Control course of instruction currently in development.

PROJECT DURATION

DEC 2017 - JUN 2018

FUNDING SPONSOR

Surface Warfare Officers School

POINTS OF CONTACT

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DESCRIPTION

This research seeks to investigate feasibility of an analysis that documents the current methods used for manipulating stressors, as well as current methods for instructors to determine trainee stress levels, how and when to modify stress cues, and strategies for identifying and eliminating or mitigating excessive trainee stress. This task analysis will build on previous efforts conducted under the DHS SBIR with DHS component representatives such as first responder groups and/or Federal Law Enforcement Training Center (FLETC), identifying both commonalities and differentiating factors in an effort to develop a training capability that is generalizable

NEED

Ruggedization of current system is necessary to collect required physiological signals within extreme physical environments expected to be encountered during naval firefighting trainees. These added specifications are expected to enhance the data and increase the capabilities of the system.

BENEFITS

The goal of this SBIR is to develop a remote, technology enabled, anger and psychological stress treatment and management tool derived from current evidence-based interventions to help service members cope with post-deployment psychological health issues outside of the clinic and their integration into the family and community.

STATUS

Physiological data were collected during sessions of the SWOS Firefighting and Damage Control Basic Course (416) and Advanced Course (419) at Naval Station Mayport. As part of the observation, sensors were donned by trainees to monitor heart rate, Electrodermal Activity (EDA), and skin temperature throughout training in the firefighting simulation. Results indicated collection of these data is possible and feasible in the extreme temperatures and moisture conditions of the firefighting training environment. The data were then used to enhance the capabilities of stress classifier algorithms to assess and report stress levels of individual trainees during simulation events.

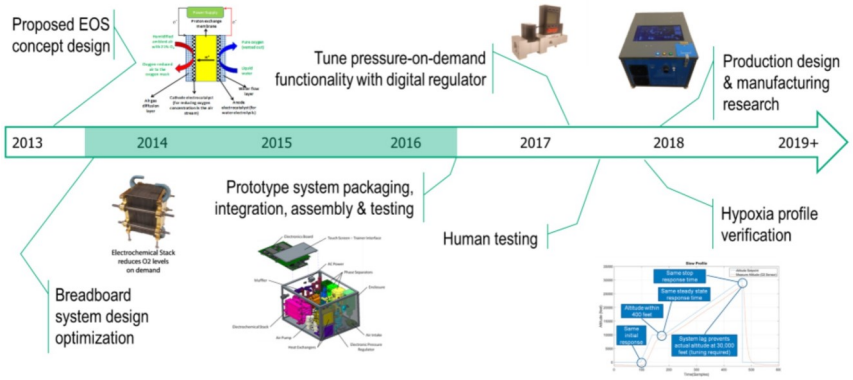
MILESTONES

- Heart rate, Electrodermal Activity (EDA), and skin temperature collected throughout training in firefighting simulation during SWOS Firefighting and Damage Control Basic Course (416) and Advanced Course (419) at Naval Station Mayport.
- Physiological data used to enhance the capability to use physiological of sensors and stress classifiers for extreme high heat and moisture training environments.
- Follow-on efforts planned to focus on integrating physiological sensor data into the SWOS Firefighting and Damage Control curriculum and potential feasibility of use in adaptive training contexts.

MASK-ON HYPOXIA TRAINING DEVICE

OBJECTIVE

The effort seeks to support the technology transition of a next generation hypoxia-training device under development as part of NAVAIR SBIR N132-093. The goals of this research include analysis of logistical concerns, human factors evaluations, and human testing to validate the fidelity and effectiveness.



Development timeline of an On-Demand Hypoxia Trainer based on research and development conducted under SBIR Phase I, Phase II and Phase II.5 efforts.

PROJECT DURATION

NOV 2013 - OCT 2019

FUNDING SPONSOR

Naval Air Systems Command (NAVAIR)

POINTS OF CONTACT

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DESCRIPTION

This effort will conduct the research and development efforts necessary for validating the fidelity, safety and concept of operations of the On-Demand Hypoxia Training Device under development for transition to PMA-205. In addition to the required research, we intend to conduct separate independent tests and evaluations to document the performance parameters and benefits of the novel technology for existing and potential acquisition communities. Specific tasks include: research and analysis of logistic requirements for training technology; conduct Human Factors Evaluation of the instructor console; conduct human testing with a military aviator population; and validation of training system.

NEED

As hypoxia continues to remain a highly visible safety issue, focus on a range of potential mitigation solutions is imperative. While a variety of engineering solutions aimed at the aircraft are being considered and tested, the final line of defense will remain in the hands of our trainers.

BENEFITS

The acknowledged success of hypoxia training makes it paramount that the Navy ensures these capabilities remain available. In addition to providing a means for addressing the larger Navy research into mitigating hypoxia physiological episodes, this effort will advance the lab's understanding of hypoxia training. Through usability analyses, researchers will document ways to increase the ease of use of the instructional capability. Further, this effort will provide the means to thoroughly investigate a novel technology to determine the effectiveness and efficiency of the devices to deliver higher fidelity training opportunities.

STATUS

A Phase II effort was completed, resulting in a refined system prototye, human research, and maintenance and sustainment analysis. A Phase II.5 effort was awarded focused on developing a second prototype to collect a breadth of data relevant for assembly line manufacturing of acquisition devices, and refining the reliability and sustainability of the system.

MILESTONES

- Phase II.5
  - Contract awarded based on Technology Transition Agreement from PMA-205 (May 2017-Aug 2018)
  - Refined prototype developed to support engineering and human testing
  - Fleet engineering testing conducted to refine pressure on demand capability
  - IRB approved for human subjects testing
- 2nd Phase II
  - Contract awarded to refine design and manufacturing research and development (July 2018-Apr 2019)
  - Refined prototype developed to support engineering and human testing
  - IRB approved for human subjects testing
  - Iterative usability testing of system and endurance and reliability testing in process

NAWCTSD supports Department of Defense (DoD) and Navy Science, Technology, Engineering and Mathematics (STEM) goals and priorities. Through Command and ONR funding support, the Program addresses the challenge to educate, train, recruit and retain personnel in STEM critical skill shortfall disciplines for National Security and Defense needs. The Navy's STEM Program, is built around five priorities:

1. **Inspire** the next generation of scientists and engineers (S&Es)

2. **Engage** students and build their STEM confidence and skills through hands-on learning activities that incorporate naval-relevant content

3. **Educate** students to be well prepared for employment in STEM careers that support the Navy and Marine Corps

4. **Employ,** retain and develop Naval STEM professionals, and

5. **Collaborate** across the Naval STEM enterprise, and with best practices organizations to maximize benefits to the Department.

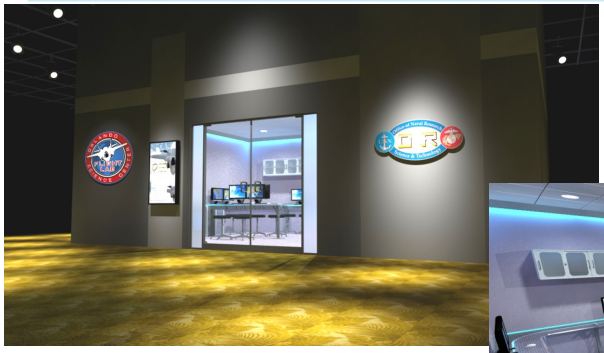
FY18 NAVY LOCAL IMPACT AT A GLANCE	
STEM Program Launched	2009
Geographic Reach	Brevard County Hillsborough County Lake County Orange County Osceola County Seminole County Volusia County
S&E Mentors & Coaches	1 part-time site coordinator 156 S&Es 15 mentors (robotics and Blankner)
Schools Reached	2 K-8 schools 8 elementary schools 23 middle schools 12 high schools Total: 45 schools in 7 school districts
Personal Interactions	186 teachers 11,461 students

To enhance STEM education in the Central Florida area, NAWCTSD has partnered with Orange, Seminole, and Brevard County Public Schools, the University of Central Florida, the National Center for Simulation Education and Workforce Development Committee, the Central Florida STEM Education Council (CFSEC) and its members, the Florida High Tech Corridor Council's techPATH, the Orlando Science Center, and the U.S. Naval Academy.

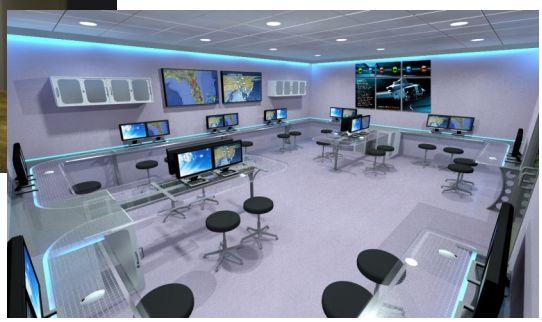
FLEXIBLE LEARNING ENVIRONMENT AVIATION CLASSROOM EXPERIENCE (FLEX-ACE): READY, SET, FLY!

OBJECTIVE

The goal of this effort is to support ONR's mission of fostering Science, Technology, Engineering, and Mathematics (STEM) education for students. Through FLEX-ACE–a U.S. Marine Corps and U.S. Navy-themed, aviation simulation classroom–students will be able to engage with hands-on, immersive, USMC/Navy-specific, STEM-related content. By reinforcing STEM



Above. Entrance to the Flight Lab at OSC.



Right. Inside of the Flight lab at OSC.

PROJECT DURATION
JAN 2017 - DEC 2018

FUNDING SPONSOR
Office of Naval Research (ONR)

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DESCRIPTION

Developed by TEQGames, the FLEX-ACE Flight Lab is a flexible aviation laboratory classroom that offers collaborative hands-on, project-based learning of STEM for students and visitors at the Orlando Science Center (OSC) in Orlando, Florida. The program concept uses inspirational real-world mission scenarios to teach standards-based STEM concepts and to develop critical communication, decision-making, team building, and collaborative skills. During this effort, the team developed and implemented multi-player FLEX-ACE mission scenarios and program assessment measures in order to evaluate user satisfaction and learning gains.

NEED

It is essential for the USMC and Navy to maintain recruitment of top STEM talent, as STEM fields are critical to the effective training and performance of the Warfighter. However, many adolescents lose interest in STEM early in their academic careers–sometimes as early as the 3rd grade. Thus, there is a need to provide meaningful, educational opportunities for youth to experience STEM "beyond the textbook." It is imperative to get children engaged in STEM in interactive ways–hence, the immersive, game-based learning environment offered by FLEX-ACE.

BENEFITS

The exhibit and overall effort:

- Support the DoD and ONR's mission of fostering K-12 STEM education.
- Engage 5th-12th grade students with hands-on, immersive USMC/Navy STEM-related content experiences.
- Inspire and motivate the next generation to explore STEM careers.
- Provide opportunities for evaluation and assessment of the impact of immersive STEM programs on students and the community.

STATUS

The ribbon-cutting ceremony for the opening of the Flight Lab was held in Jan 2018. As of the end of FY18, there were approximately 2,292 visitors to the Flight Lab. Development of reaction surveys and learning assessments was completed in March and June, respectively. Respondents (N ≈ 500) to the general visitor reaction surveys indicated enjoying the Flight Lab experience and wanting to return. Likewise, most of the 24 summer camp attendees also reported liking the Flight Lab. The campers also showed a 21% learning gain in pre-/posttest learning assessments.

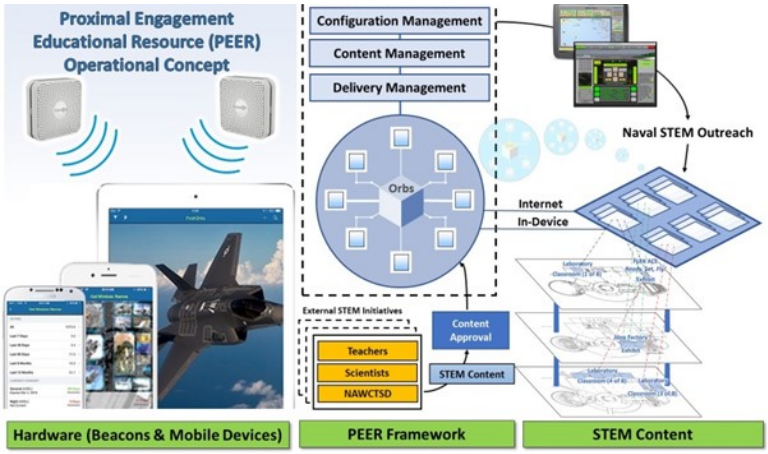
MILESTONES

- Jan 2018 – Ribbon-cutting ceremony to mark Flight Lab opening was attended by several VIPs, including Orlando Mayor Buddy Dyer; Orlando City Commissioner Robert Stuart; NAWCSTD Executive Officer CAPT Hill; Program Manager for Training Systems (PM TRASYS) Col. William Yates; ONR Code 30 Program Officer Dr. Peter Squire; TEQ Games President John Fitzgibbon; OSC President & CEO JoAnn Newman.
- Mar & Sep 2018 – Presented program progress at the HPT&E Technical Reviews in Alexandria, VA
- Jul 2018 – Completed learning assessments for 2018 Aviation Adventures Summer Camp attendees
- Aug & Sep 2018 – Analyzed data from reaction surveys and summer camp learning assessments

PROXIMAL ENGAGEMENT EDUCATIONAL RESOURCES (PEER)

OBJECTIVE

The objective of the Proximal Engagement Educational Resource (PEER) was to provide a new interactive Science, Technology, Engineering, and Mathematics (STEM) enhanced learning experiences throughout classrooms and events using Proximal Web technologies. The STEM content delivered was developed in coordination with NAWCTSD and participating local school districts and aligning with the Naval Ready Relevant Learning (RRL) construct.



GBL, Inc. image of technology concept

PROJECT DURATION

APR 2018 - DEC2018

FUNDING SPONSOR

Office of Secretary of Defense (OSD)

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DESCRIPTION

PEER delivered learning content to individual students' mobile devices allowing them to work at their own pace, and quiz them on the attained knowledge. PEER permitted the instructor to (1) control the content given to the student(s) and (2) continue on with the material without any student being left behind when they require more time. This easily modifiable immersive learning content delivery system exposed participants to STEM learning challenges in both military and non-military scenarios. Because of the ease of management and brief latency time of postings, these Orbs can be created to remain current with the latest program launches, application processes, and candidate criteria.

NEED

The PEER project created a scalable new type of immersive STEM engagement environment for underserved population. PEER technologies allowed the teachers to manage specific sites where students viewed web content as Orbs on mobile devices. This was accomplished by disabling the browser on the mobile devices, potentially simplifying information assurance protection e.g. lower probability of ransomware cyber attack.

BENEFITS

The PEER project leveraged technologies successfully demonstrated at I/ITSEC and expand the reach across local middle and high schools, as well as local high school and university career education centers. The project commenced with participation in I/ITSEC STEM day, where students and educators partook in Treasure Hunt activities to learn STEM required critical thinking in a fun game-like environment to target engaged student participation. The project implemented PEER pilots across the local classrooms at the selected middle and high schools and university career education centers. Finally, the project showcased composite results across all pilot programs for presentation and utilization at I/ITSEC.

STATUS

The PEER STEM learning environment was established across six local K-12 schools and two career education centers (high school and university). The PEER pilot at I/ITSEC served as a replicable PEER Venue Package, which can be established and taken down for re-use across unlimited number of public events. The PEER project strengthened the local school districts with a revolutionary STEM learning experience, while infusing STEM workforce into Navy/DoD careers.

MILESTONES

- The PEER STEM learning environment was established across:
  - 6 local K-12 classrooms
  - 2 career education centers
  - I/ITSEC conference

LABORATORY CAPABILITIES

At the Naval Air Warfare Center Training Systems Division (NAWCTSD), we have many laboratories engaged in research and development. These labs work to advance the state-of-the-art in training technologies in human factors, human-machine interfaces, augmented reality and virtual reality, data analysis, acoustics and sensors, visual systems, data analysis, fabrication, interoperability, Live-Virtual-Constructive applications and technologies, communications, and more. The following section provides summaries the capabilities of the labs with examples of on-going research project.

BATTLE LAB

Basic & Applied Training & Technology for Learning & Evaluation Lab

MISSION

Conduct and manage science and technology (S&T), research and development (R&D), transition and acquisition consultation efforts through the application of cognitive science, behavioral research and training evaluations to improve training and human performance in a variety of learning environments.

EXPERTISE

- Research Psychologists
  - Applied Experimental
  - Human Factors
  - Industrial/Organizational
  - Modeling and Simulation
  - Criminal Justice
- Aerospace Experimental Psychologist
- Systems Engineer
- Systems Analyst
- Training Specialist
- Navy Subject Matter Experts

For More Information Please Contact

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Areas of Emphasis

Human Performance Assessment & Data Science

- Performance Metrics & Assessment
- Post Mission Reporting & Analysis
- Statistical & Algorithm-based Trend Analysis

Instructional Strategies & Technologies

- Adaptive Training
- Intelligent Tutoring Systems
- Performance Feedback, After Action Review
- Vigilance & Decision Making

Training & Instructor Support Tools

- Speech Recognition, Understanding, & Synthesis
- Behavior Models
- Emerging Technology Evaluation Methods

Recent Projects

Post Mission Assessment for Tactical Training – Trend Analysis

The **PMATT-TA** software suite is a centralized, readiness data archival and analysis system that includes a SIPR-based web application and underlying database, as well as instructor qualification gradesheets and automated system-based performance measures. These technologies reduce manual data entry and analysis to increase data reliability. Further, a centralized repository of performance data provides a capability to accurately gauge overall fleet readiness at a competency-based level and provides a means to deliver targeted training for remediation and proficiency.

Data Science for Performance Assessment & Enhanced Training

The **Techniques to Adjust Computational Trends Involving Changing Data (TACTIC-D)** effort is working to develop technology based on statistical or computational methods to assist in the continued tracking of training performance and proficiency trends as underlying data changes. To increase re-use of available data, the **Repurposing Computational Analyses of Tactics for Training Assessments** is focused on the design and development a software technology that leverages data science and advanced computational analyses of tactical data sources to improve training scenarios and assessments and make training more adaptive, efficient, and effective.

BATTLE LAB

Basic & Applied Training & Technology for Learning & Evaluation Lab

Team-based Advances Resilience Accelerator (TARA)

TARA is a team behavior measurement and feedback system that will support coaching, mentoring, training, and self-assessment of team skills. TARA will support performance assessments over time to allow instructors and teams to discover the deep connections that exist between their actions, the task conditions, and outcomes, which will provide them with the foundation they need to act and make intuitive decisions as a resilient team. The TARA system is comprised of Submarine SPOTLITE, for online assessments and immediate performance feedback, and Learning Locker, for storing and tracking team performance over time. Together, these provide benefits for instructor and trainee in terms of understanding a team's strengths and weaknesses, and by using this knowledge to select the optimal training path for the team.

Accelerating the Development of Small Unit Decision Making (ADSUDM)

The objective of ADSUDM is to develop tools and techniques to accelerate the development of small unit decision making skills for the infantry by increasing the quantity and quality of Decision Making training, and consists of three products. The **Digital Integrated Representation of Tactical Environment** (DIRTE) provides a means for small unit instructors to select and/or create and visualize terrains to support decision making training. **Situated, Tailored, Training & Assessment** (ST2A) is a software-based situated tutor for providing adaptive training to increase proficiency. Finally, the **Decision Making-Learning Management System** (DM-LMS) provides a repository for storing SUDM performance metrics and providing After Action Review Capabilities.

Team/ Squad Overmatch (SOvM)

This year, SOvM developed team resilience strategies that focus on the recognition of self/buddy cues that illustrate acute stress reactions and teaches 'tactical resilience care' behaviors to provide on the spot stress injury care. SOvM integrates cognitive skills in tactical exercises to increase skill development and training transfer through SOvM. SOvM Train the Trainer (T3) software provides comprehensive planning and execution support for conducting a platoon level exercise with integrated cognitive skill strategies, practice scenarios, curriculum, and performance measurement.

Crew Role-player Enabled by Automated Technology Enhancements (CREATE)

The CREATE software suite provides synthetic crew role players to support complex crewmember interactions during dynamic training events. Currently, Navy crew training requires the assembly of an entire crew or the use of Subject Matter Experts to support crew training. While training benefits from bringing a full crew together, some individual training could benefit from added realism. The technology under development provides a synthetic role-player capability to supplement training by integrating speech capabilities, SME-level tactical domain information, reaction to multitasking and high-stress situations, and relay of information via means other than speech communication.

Hypoxia Training & Symptomology

The **On Demand Hypoxia Trainer (ODHT)** is a mobile-sized hypoxia training device capable of delivering continuous pressure-on-demand airflow to an aviator's oxygen mask with varying oxygen levels. The development of this technology provides an alternative training system that minimizes existing training gaps due to air hunger while increasing fidelity of training experience through pressure-on-demand capability. In parallel with this effort, the team is investigating **Construct Correspondence of Physiological and Subjective Measures of Hypoxia.** The objective of this research effort is to evaluate the relationship between extant physiological measures and subjective measures of hypoxia symptoms in order to better understand physiological hazard report data from aviators and improve hypoxia awareness and mitigation training.

Concept Development & Integration Lab (CDIL)

MISSION

Research and Development of specialized, interoperable Live-Virtual-Constructive applications and technologies; provide smart buyer awareness to training system acquisition programs.

EXPERTISE

- Computer Scientists
- Computer Engineers
- Electrical Engineers
- Electrical Technicians
- Subject Matter Experts

For More Information Please Contact

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CAPABILITIES

Electronic Communications Subject Matter Expertise

- Voice Communications (Analog & Digital)
- Live-Virtual Interoperability
- RF Propagation / Antenna Analysis

Cyber Warfare Training Devices

- Realistic emulation of Network and Host based Cyber-space attacks
- Cyber Data Modeling (Data Exchange Model / Threat Effects Database

Rapid Prototyping / Proof of Principle Development

- Requirements -> First Article Test
- Application Development / System Integration (Hardware & Software)

Software Development

Hardware /Electronic Design & Fabrication

TEMPEST Separation & Certification

- Voice Communications
- Cyber Warfare
- Modeling and Simulation

Acquisition Support

- Technical Consulting
- Commercial Market Surveillance
- Documentation Review

Concept Development & Integration Lab (CDIL)

Supported Projects and Focus Areas

Virtual Radios

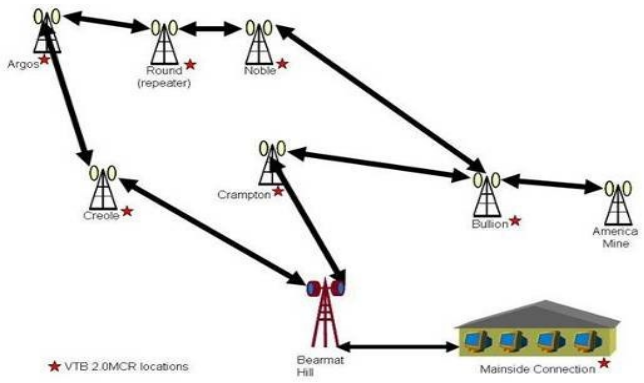
- Low cost, software based, low or high fidelity tactical radios
- Integrated Battle Force Tactical Trainer Digital Voice (IBDV)
- Marine Digital Voice (MDV)
- Tactical Radio Interfaces, e.g. SINCGARS, MBITR (PRC-148)
- Digital Radio Management System (DRMS)
- Remote Interface Controller (RIC) Radio Console

Live-Virtual Communications

- Virtual Tactical Bridge (VTB)
- DIS-VoIP; DIS-Analog Telephony; DIS-HLA
- Secure Voice Transport
- Live-Virtual Radio Trunking

Live & Virtual Radio Management

- Remote Interface Controller
- Master Control Station
- Remote Radio Control, Monitoring and Operations
- Radio Optimization / 'Smart Antenna Algorithms'



Cross Domain Communications

- Multi-Modal Consoles
- Enterprise Network Guard (ENG)

Communications Modeling

- Terrain Effects Server
- Cyber Data Exchange Model

Cyber Warfare Training

- Network Emulation Effects System (NE2S)
- "Cyber for Others" / Battle Staff Training

Computer Based Training

- Pallus / MTX Blue Force Tracking
- MBITR
- CYZ-10

After Action Review

- Record and Play (RAP)

Tech /Exercise Control

- Joint Voice Communications Validation Tool (JVCVT)
- Basic and Advanced Virtual Communications Diagnostics including 'Wizard' Capability (DIS/HLA)
- FIPS Compliant Wireless Interface Controller

Interoperability Design Engineering and Application (IDEA) Lab

MISSON

Support research, development, test and evaluation of training systems interoperability. The lab provides tools for visual systems analysis, database development, system integration and command demonstrations.

EXPERTISE

- Computer Scientists/Engineers
- Interoperability Engineers
- Configuration Management
- Quality Assurance
- Cyber and IT Support

For More Information Please Contact

NAWCTSD Technology Transfer Program Manager

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CAPABILITIES

- Trainer Interoperability Testing Environment
- Cross-Domain Solutions
- Common Simulation Products
- Interoperability Test Tools
- R&D Simulation Tools
- Mission Training Test Tools
- Software Development
- Configuration Management
- Quality Assurance
- 180 degree visual display w/ 3 LCD Projectors
- 3 Channel PC based IG & Video Switch
- Network Connections for NCTE, SIPR, NMCI and DMON

Interoperability R&D Tools and Integration Services

FACTT Suite (Federation Agreements Compliance Test Tool)

- Composed of several plug-ins that enable automated testing, logging and stimulation of training systems.
- Required toolset for testing all Navy Aviation Simulation Master Plan training systems

NFTII (Navy Federate Trainer Information Index)

- Database composed of capabilities and limitations for every Navy aviation training system
- Will be utilized by Navy Aviation Distributed Training Center (NADTC) personnel for scenario planning

JBUS (Joint Simulation Bus) NASMP Plug-in

- JBUS is an NWDC software product used to translate between NASMP standard and other simulation standards/protocols (gateway)
- IDEA Lab develops a specific NASMP Plug-in to support Navy Aviation trainers

Virtual Aviation Distributed Environment and Research (VADER)

- Connected to Navy Continuous Training Environment (NCTE)
- R&D Asset for verifying trainer interoperability and an active test bed for research.
- All Navy Aviation training systems are required to integrate with VADER after each upgrade.

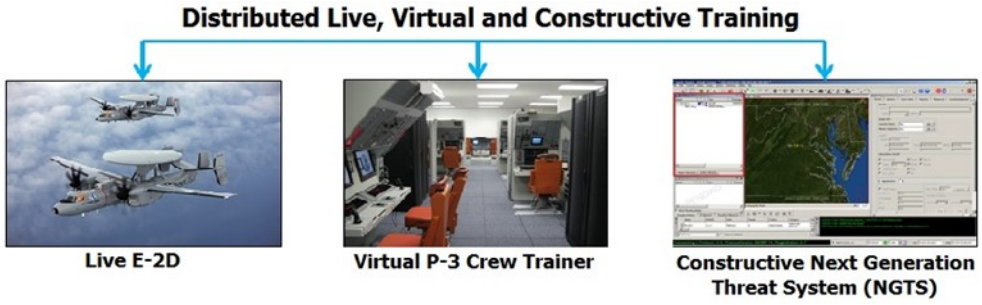
Distributed Training Network Guard (DTNG)

- Authorized Controlled Interface for distributed training between same security levels (Government Off The Shelf (GOTS))
- Supports training system training requirements to protect “need to know” data

Navy Portable Source Initiative (NPSI)

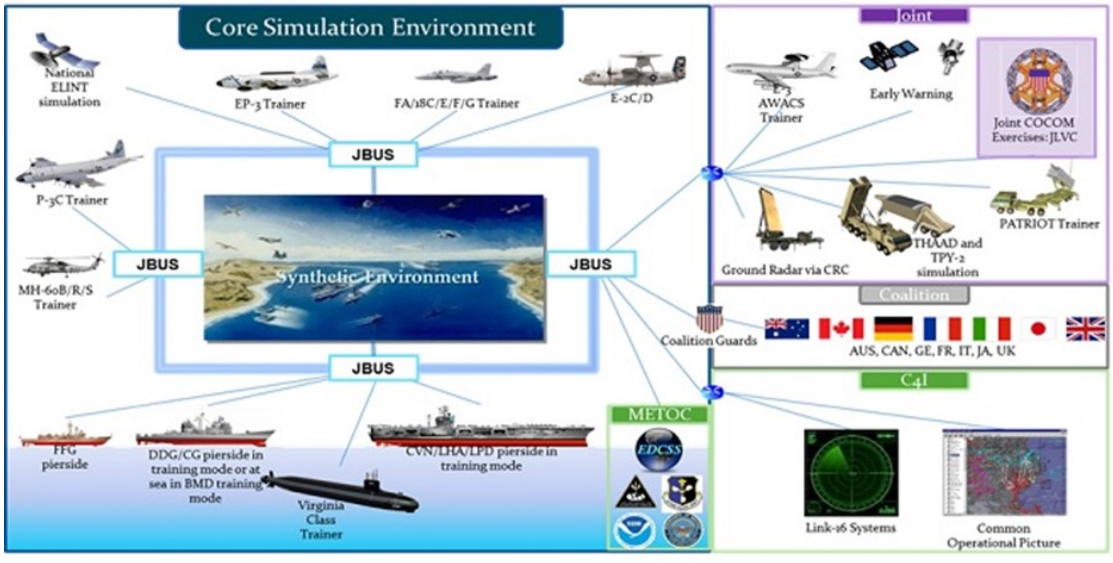
- Provides maximum source data reuse across training devices for various Type/Model/Series platforms to lower the life cycle cost of Out-The-Window (OTW) visual, sensor, terrain, and 3-D model databases

Interoperability Design Engineering and Application (IDEA) Lab



Fleet Synthetic Training (FST) Supported

- **FST-J (Joint)**
  - ◊ Largest Event
  - ◊ Army, Navy, Air Force, Marines
  - ◊ Coalition Partners
- **FST-GC (Group Commander)**
  - ◊ Medium sized event
- **FST-WC (Warfare Commander)**
  - ◊ Small Event
- **FST-A (Aviation)**
  - ◊ Aircrew primary training audience. Occurs daily or weekly



Supported Platforms:

MQ-4C Triton
MQ-8B/C Fire Scout
UCLASS
H60-R, H60-S
F/A-18 C/D/E/F
E/A-18 G
E-2 C/D
P-3C
P-8A
AAS

Littoral Combat Ship (LCS) Laboratory

MISSION

Support developmental systems, rapid reconfigurability, and special hardware and software requirements sustainment of Littoral Combat Ship Training Systems.

EXPERTISE

- Information Technology
- Cyber Security
- System Engineering
- Instructional Systems Design

For More Information Please Contact

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Virtual Ship Training System (VSTS)

The Virtual Ship Training System (VSTS) consists of a virtual training environment network infrastructure located at Littoral Combat Ship Training Facilities (LTF). The LTF VSTS supports individual, multiple, and team training for Seaframe and Mission Module Detachment (MMDET) crew to train to qualify (T2Q) watch stander and train to certify (T2C) team training requirements. The virtual environment will be networked with all physical simulators for visualization, communications and systems operations to enable expanded individual and team training events.

The LCS Lab provides configuration management of the IVSE courseware, Virtual Ship Training Systems (VSTS) products and various trainers and training systems located at the LCS Training Facilities (LTFs).

The LCS Lab has virtualized the VSTS environment used to network, integrate, centrally administer, troubleshoot, sustain, and provide cybersecurity to all LTF trainers, including the Virtual Reality Labs (VRLs). This virtualized VSTS environment is provided in a rack-mounted system to different OEM vendors for the in-plant integration and testing of their LCS trainers.

Cybersecurity Support – The LCS Lab can serve as the repository of updates and patches for the unconnected trainers (not only LCS). Utilizing synchronization of repository databases, the lab can scan for patches and updates and download those required for an unconnected trainer.

Prototyping – Training Equipment Change Requests (TECRs) can be prototyped and tested in the lab before deploying them in a production environment.

External Product Integration – The LCS Lab have utilized the baselined VSTS environment to integrate, setup, and test with external products, adding training capabilities to the LTFs.

Littoral Combat Ship (LCS) Laboratory

Training Sites:

San Diego, California

Mayport, Florida

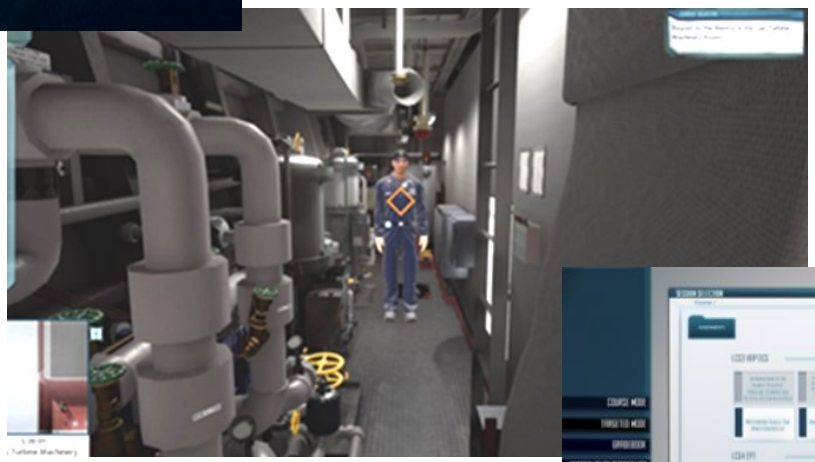
LCS Lab Products

Virtual Ship Training Systems (VSTS) – Provides Network Infrastructure Services, Sustainment, Cyber security, and Centralized Management of Training Systems.

STAVE-LCS IT – Information Technology training system that brings the LCS ship IT environment virtually to train Sailors on managing the IT systems of the ship.

Virtual Reality Laboratory (VRL) - Student and Instructor Station Hardware Platform that can support multiple training environments.

Immersive Virtual Shipboard Environment (IVSE) - Install Courseware into hardware platform. Integrate to VSTS and create baselines for distribution to LTF.



Live, Virtual, Constructive, Modeling & Simulation (LVCMS) Lab

P-3 Air Crew Tactical Team Trainer

MISSION

Development of computer software, including computer system architecture and system software organization for Live, Virtual, and Constructive Modeling and Simulation Trainers, specializing in Anti-submarine Warfare and Virtual At-Sea Training Systems.

EXPERTISE

- Computer Scientists
- Computer Engineers
- Subject Matter Experts

For More Information Please Contact

NAWCTSD Technology Transfer Program Manager

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Capabilities and Sample Projects

The lab leverages common acoustic products across multiple training systems to optimize development cycles and expertise. These products include a Passive Generator used to create realistic audio for passive sensors, AP Module used to create realistic audio for active sensors and DOG which provides environmental data that is used in the modeling of the ocean environment. This data may be retrieved from the HLA network, a database, or file depending on the case.

Bravo Air Crew Tactical Team Trainer (BATTT) The Anti-Submarine Warfare (ASW) Virtual-at-Sea Training (VAST) Bravo Acoustic Tactical Team Trainer (BATTT) system is a networked, PC-based, deployable trainer designed to support integrated and coordinated ASW tactical training and enhance team decision making for Navy Seahawk SH-60B crews. The current training system configuration is comprised of personal computers, with each representing a crew station (Pilot, Airborne Tactical Officer (ATO), and Sensor Operator (SO)) and an Instructor/Operator Station (IOS). The system uses the same tactical software program employed by the SH-60B. The BATTT system's flexible design consists of a Tape Handling Package (THP) emulator, enabling rapid upgrades to the BATTT tactical software program to match the latest versions used in the Fleet.

Romeo Air Crew Tactical Team Trainer (RATTT) is a networked, PC-based, deployable trainer designed to support integrated and coordinated ASW tactical training and enhance team decision making for Navy Seahawk SH-60R crews. Capabilities of the RATTT include: Radar, Hellfire air-to-surface missiles, and Identification Friendly or Foe (IFF) designed for command and control and SAU7000 message standards. The Link16, a military tactical data exchange network, was upgraded and integrated for use in the RATTT system. This allows military aircraft as well as ships and ground forces to exchange their tactical picture in near-real time. These capabilities expanded the synthetic training environment incorporating critical warfighting platforms providing Sea Combat Commanders with additional assets to aid in decision making processes. Technologies from the ASW Virtual-at-Sea Training (VAST) BATTT system were leveraged to quickly allow for engineering development and test.

Live, Virtual, Constructive, Modeling & Simulation (LVCMS) Lab

P-3 Air Crew Tactical Team Trainer (PACT3) provides the first ever PC-based (small foot-print, low cost) training capability for currently fielded P-3 Maritime Patrol Aircraft that can be reused with very minor flight dynamics model modifications to represent the Navy's future P-8A Maritime Patrol Aircraft, allowing cross platform (Aviation, Surface, Undersea) coordinated ASW integrated team training. Five of the P-3 Stations and an Instructor Station have been developed for the PACT3 system. The five Stations currently developed are: Pilot, Tactical Coordinator (TACCO), and Sensors 1, 2, and 3. The PACT3 provides Science and Technology (S&T) innovation in four principal areas: (1) non-acoustics stimulation, signal processing, and display, (2) acoustics processing, (3) training system capacities, and (4) system interoperability. PACT3 is helping to curb a critical training gap by delivering deployed aircrew training up to three years ahead of the standard acquisition process. The PACT3 leveraged from the development of previous trainers including the ASW Virtual-At-Sea Training (VAST) Mission Rehearsal Tactical Team Trainer (MRT3) deployable trainer and the Effective Active Acoustic Simulation (EFAAS) technology baseline.

Bravo Romeo Acoustic Stimulation System (BRASS): BRASS for Sea Combat Commander (SCC) is an effort for providing the Anti-Submarine Warfare (ASW) characteristics of the MH-60R Helicopter Platform stimulating the Aircraft Carrier Tactical Support Center (CV-TSC) using the SAU07000 message standard. The capabilities include stimulation of Directional Low Frequency Analysis and Recording Buoy (DIFAR), Directional Command Active Sonobuoy System (DICASS), Bathythermograph (BT) sonobuoys, and Acoustic Low Frequency Sonar (ALFS) dipping sonar. Additional capabilities include simulation of the MH-60R Radar to provide the non-acoustic ASW functionality. This will provide the SCC with the data necessary for ASW Tactical Training. BRASS is a stimulation training application to be incorporated into the High Fidelity Active Sonar Training Command (HIFAST-CMD) system. HIFAST-CMD is a high level program being developed to improve integrated, staff level Undersea Warfare (USW) training. This software could be distributed to all aircraft carriers to be integrated during Fleet Synthetic Training (FST) events and into the platform systems to communicate with the Carrier Based Tactical Support Center (CV-TSC), providing acoustic data from sonobuoy input to the AN/SQQ-34C.

Mine Countermeasures Aircrew Training System (MCATS) The AN/AQS-24B Sonar Mine Detecting Set is a high-speed, high-resolution sonar system with the capability to implement a laser line scan (LLS) sub-section for the detection, classification and identification of mine-like objects. The primary operational platform for this system is the MH-53E helicopter used by Helicopter Mine Countermeasures Squadrons. The complete system consists of aircraft mission equipment (operator console, tow cable, and towed vehicle) and other supporting tools and apparatus used for post mission analysis of recorded mission data and deployable maintenance facilities. The AN/AQS-24B system is the primary mine-hunting asset for current Concept of Operations (CONOPs) plans. The MCATS trainer will consist of an Instructor Station; two (2) controller stations - the Helicopter SONAR Operator (HSO) and the Data Analyst Operator (DAO); and a Sensor Stimulation of the tactical hardware. The training system will provide simulated inflight and ground training for the aircrew and will simulate HSO and DAO duties during an AN/AQS-24B mission from start to finish. The trainer will be able to simulate initial system set-up, pre-mission Built In Test (BIT) , inflight data collection and system operation, SONAR return, inflight data analysis, and post mission BIT tests. The trainer will also include numerous other features required for HSO and DAO qualifications.

Multipurpose Reconfigurable Training System 3D® (MRTS 3D®) Lab

MISSION

To provide fully immersive training environments via a common architecture for low-cost, rapidly-deployable training solutions.

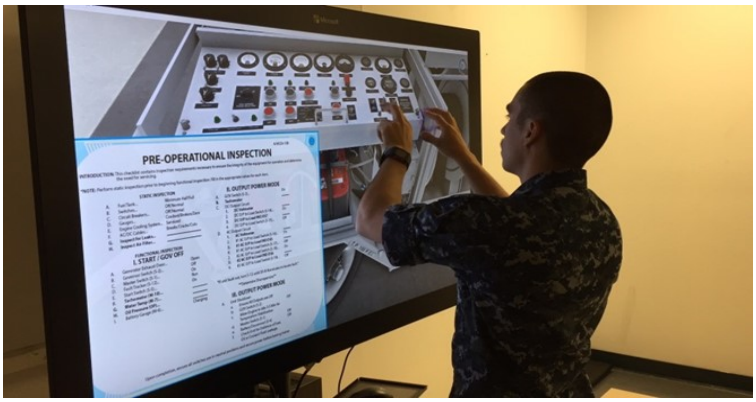
EXPERTISE

- Computer Scientists
- Computer Engineers
- Subject Matter Experts

CAPABILITIES

The Multipurpose Reconfigurable Training System 3D® (MRTS 3D®) family of trainers provide virtual training environments simulating a variety of aviation, surface, and submarine platforms, weapons, and electronic warfare systems. Each trainer consists of government-owned and developed simulation software running on a stand-alone network of Commercial-Off-The-Shelf (COTS) hardware and software components. A single MRTS 3D hardware trainer can shift between multiple software simulation applications in a few minutes. This capability enables the school to use one hardware suite to give photo-realistic virtual training on several different systems in a single day.

The MRTS 3D trainers are used in both Sailor pipeline courses and in pre-deployment team training. The instructor can manage configurations and scenarios while the students follow procedures, interact with the touch screens, and coordinate with the other stations across training scenarios.



For More Information Please Contact

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Multipurpose Reconfigurable Training System 3D® (MRTS 3D®) Lab

Supported Projects and Focus Areas

Fielded MRTS 3D Applications

- VIRGINIA Torpedo Room
- VIRGINIA Block I/II Torpedo Room & VLS
- VIRGINIA Block III Torpedo Room & VLS
- VIRGINIA Emergency Diesel Generator (EDG)
- Mobile Electric Power Plant (MEPP)

Supported Sites

- Groton, CT
- Norfolk, VA
- Kings Bay, GA
- Pensacola, FL
- Bangor, WA
- San Diego, CA
- Pearl Harbor, HA
- Guam

Navigation Laboratory (NAVLAB)

MISSION

Provide full trainer life cycle support for the SPAN/VESUB submarine navigation trainers of record including software/systems development, integration test, design, packaging, and fielded updates.

EXPERTISE

- Computer Engineers/Scientists
- Submarine Subject Matter Expert

CAPABILITIES

The lab utilizes an integrated development environment and modular test berth to perform trainer support functions:

- Software design and development from Fleet requirements to Fleet Acceptance, based on In-House Development Process (iDP) and In-House System Engineering Technical Review (iSETR).
- Immersive, mixed-reality environments for multiple submarine baselines
- Modeling and simulation of tactical systems
- Distributed system design using High Level Architecture (HLA) and TCP/IP network.
- Modeling and simulation of virtual harbor navigation
- Software integration and testing facility
- System delivery and upgrade with full technical and logistics support

The Submarine Piloting and Navigation (SPAN) Trainer

The SPAN trainer provides team and individual training in piloting and navigation principles of a surfaced submarine for the Helmsman, Fathometer Operator, Navigation Center Operator, Voyage Management Operator, Contact Coordinator, Periscope Operator, RADAR Operator, Officer of the Deck, and Lookout. The team uses navigation techniques and simulated on-board equipment to ensure the ship is safely piloted and navigated in various harbors, under variable environmental conditions. Training exercise requirements are designed into training scenarios, developed and controlled by the instructor utilizing the trainer's scenario tools at the Instructor Operator Station (IOS).

For More Information Please Contact

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Navigation Laboratory (NAVLAB)

Virtual Environment for Submarine Ship Handling (VESUB) Trainer

The VESUB trainer is a virtual reality-based computer system utilizing immersive Virtual Environment and Head Mounted Display (HMD) technology. The trainer consists of Commercial-Off-The-Shelf (COTS) hardware and software integrated with custom software as a system. It is comprised of an IOS, visual system, student station, voice recognition/synthesis system, audio system, and multiple screen displays. It provides the Officer Of the Deck (OOD) student individual instruction in the knowledge and skills necessary to successfully and safely pilot and maneuver a surfaced submarine through restricted harbors/waterways avoiding collisions and grounding.

Rapid Design, Development and Fabrication (RD2F) Laboratory

MISSION

The RD2F Lab performs organic research and development, advanced concept demonstration, rapid prototyping, limited quantity production, and technology insertion of a wide range of modeling and simulation technologies including traditional simulation and scenegraphs, mixed-reality hardware and software, game-based virtual environments, virtual and augmented realities, (VR, AR) artificial intelligence, machine learning, mobile applications, embedded control, and electro-optics. RD2F also provides technical capabilities in multiplatform software application development, three dimenensional (3D) visual content and terrain modeling, 3D computer aided hardware design and fabrication, electronic circuit design and fabrication, additive manufacturing, machining, hardware / software integration, digital signal

EXPERTISE

- Computer Engineers/Scientists
- Electronics Engineers
- Mechanical Engineers
- Mechanical Technician

For More Information Please Contact

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CAPABILITIES

- **Turnkey Training System and Technology Development**
- **Virtual Environment and Game-based Technology** capabilities include (1) simulation-based training system development; (2) Virtual and Augmented Reality applications,;(3) interactive/immersive software and courseware, virtual content, terrain and model development, hand-held toolset/equipment integration with virtual environments, constructive simulation, instructor support and after action review software.
- **Enterprise Data Analysis, Modeling and Tools** capabilities include enterprise-scale structured and unstructured data mining and root cause analysis, machine learning, custom data collection and manipulation applications, and data visualization.
- **Software Application Development** capabilities include: (1) cross platform mobile development, (2) distributed and embedded applications, (3) turn-key prototype software, (4) real-time embedded hardware integration, (5) machine vision and intelligence, (6) adaptive applications, and (7) integrated graphical user interfaces.
- **Electronic Design and Fabrication** capabilities include: (1) circuit design involving analog, digital, embedded intelligence, wired interfaces (Ethernet, USB, RS-232, RS-485, I2C) and wireless interfaces (Wi-Fi, Bluetooth, ZigBee); (2) printed circuit board layout; (3) outsourcing of printed circuit board fabrication; (4) prototype and small-quantity board population; (5) firmware development,; (6) enclosure design (modified commercial-off-the-shelf or fully customized),; (7) device design and documentation; (8) device fabrication and assembly; and (9) production of electronic test equipment suites.
- **Mechanical design and fabrication** capabilities include: (1) Part and assembly design and assemblies, electro-optical devices, and pneumatic systems;(2) modeling in 3D)Computer Aided Design (CAD) environments;(3) Virtual prototyping with 3D assemblies (test form and fit before first article production),;(4) technical documentation production; and (5) fabrication. Fabrication using a variety of materials (plastics, non-ferrous metals, stainless steels) includes use of CNC machining using CAM software and supporting machining (grinding, cutting, hole-making). Prototype and low rate production are supported. High quantity production and operation are outsourced through NAWCTSD's contracting department.
- **Additive Manufacturing (AM or 3D Printing)** capabilities include fused deposition modeling (FDM) using ABS thermoplastic for simple low-resolution geometries, producing strong parts that are relatively inexpensive; and Polyjet 3D printing for complex, detailed, high-resolution parts, using a wide variety of photopolymers that can contain multiple and/or blended materials. Through AM, the RD2F Lab provides customers with conceptual models for visualization and form/fit; scale models for familiarity and assembly/disassembly training; jigs, fixtures, molds; prototype parts; and functional parts.

Rapid Design, Development and Fabrication (RD2F) Laboratory

Supported Projects and Focus Areas

- **Flight Deck Crew Refresher Training Expansion Packs** is an expandable framework of game engine based, immersive 3D flight deck crew Training Expansion Packs (TEPs) for use by trainees in Fleet Concentration Areas.
- **Mixed Reality Catapult Launch System Trainer** is a virtual environment aircraft catapult launch training device utilizing low cost virtual reality and game-based technologies.
- **Normobaric Hypoxia Training System** is a multi-crew hypoxia training chamber capable of rapid ascent and decent in simulated altitude while maintaining standard atmospheric pressure within the training enclosure.
- **E-28 Arresting Gear System Maintenance Trainer** is an interactive 3D self-paced maintenance training, refresh and reference courseware application compatible with the Navy Marine Corps Intranet System and is xAPI enabled.
- **Prototype Littoral Combat Ship MOBICON Training System** was developed using a AAA game engine and includes a replica MOBICON control panel with USB connectivity, has physically accurate vehicle dynamics, artificial intelligence, pathfinding and a touchscreen graphical user interface.
- **2F107 KC-130 Flight Trainer Synchro Controller** is a reengineered circuit board for trainer life-cycle extension.
- **Low-cost basic applied research program**, the RD2Fteam is evaluating low-cost commercial-off-the-shelf 3D immersive technologies for VR training. Gesture interaction in the virtual world is being investigated.
- **Process Triage and Evacuation Control Trainer (ProTECT)** is an immersive dynamic decision-making simulation for military triage was developed using a AAA game engine.
- **Simulated Joint Laser Target Designator (JLTD)** is a 1:1 scale replica of the JLTD created with 3D printing technology, and instrumented to function via HDMI and USB interface with laptop hosted virtual environments.
- **Prototype Modular Advanced Technologies-Marksmanship Proficiency (MAT-MP)** is a reconfigurable small arms instrumentation kit of patent-pending assessment and diagnostic tools for use on the live-fire range by marksmanship instructors/coaches.
- **Scenario Planning and Effects Control System (SPECS) with After Action Review (AAR)** is a turn-key instrumentation solution for immersive training sites that enables instructor/operators to provide highly detailed and repeatable training scenarios.
- **Universal Ejection Seat Trainer G-Force and Pneumatic Monitoring System** is an embedded training system safety monitoring sub-system provided as a life-cycle extension modification.
- **eHelm** is a cross platform mobile application providing extensive content management, course content presentation, and student tracking.
- **Supporting Arms Virtual Trainer(SAVT)** is the Marine Corps accredited simulation-based trainer of record for Joint Tactical Air Controllers, Forward Observers, and Forward Air Controllers.


TEP Flight Deck


E-28 3D Courseware


2F107 Synchro Board


Simulated JLTD


SAVT System

STEALTH LAB

Science for Training, Evaluation, Analysis, Learning and Theory Lab

MISSION

Conduct Research and Development to support the design and development of training programs and instructional tools through application of advanced technologies, training effectiveness evaluations and human-computer interface design.

EXPERTISE

Research Psychologists (B.S./M.A./Ph.D.'s)

- Applied Experimental and Humam Factors
- Industrial/Organizational
- Modeling and Simulation

For More Information Please Contact

NAWCTSD Technology Transfer Program Manager

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CAPABILITIES

Support for Design and Development of Training Programs and Instructional Tools

- Front End Analysis Tools/Techniques
- Cognitive Task Analyses for multi-teams and systems
- Job Task Analysis
- Types of Feedback
- Adaptive Training
- Cross-culture Teams
- Training Effectiveness Evaluations
- Human Computer Interface Design

Application of Advanced Technologies in Training Systems

- Live, Virtual, and Constructive (LVC)
- Augmented Reality
- Games and Gamification
- Multi-user Virtual Environments
- Virtual Worlds

RECENT PROJECTS

Live, Virtual, and Constructive (LVC)

The team, in collaboration with NAWCTSD Aero Engineering, NAWCAD PAX, and industry, has integrated a tactics and speech demonstration in an LVC training event, integrated an avionics symbology demonstration in an LVC training environment, participated in Operation Blended Warrior (OBW) events. LVC work includes:

- Virtual-Constructive Representations on Live Avionics Displays
- Tactical & Natural Language Capable Semi-Automated Forces
- LVC TF Naval Integrated Fire Control-Counter Air Extension
- Cognitive Fidelity Synthetic Environment
- EDUCAT2E FLEET2

STEALTH LAB

Science for Training, Evaluation, Analysis, Learning and Theory Lab

Investigation of Training Fidelity for Carrier Qualification and Precision Landing Modes

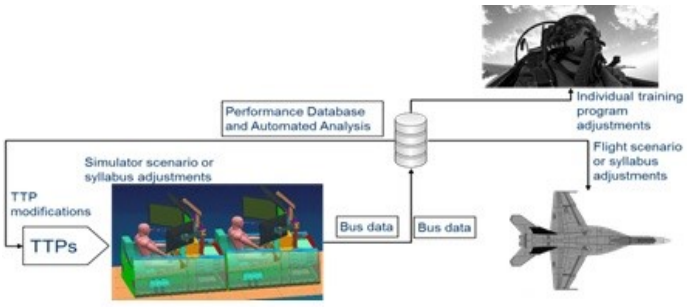
Precision Landing Mode (PLM) refers to a set of control laws that adds additional landing modes designed to improve pilot landing and recovery capabilities. These control laws decrease workload for pilots and improve aspects of recovery and landing performance (e.g., centralized landing patterns). However, the reaction of the aircraft to inputs from the pilot is different and the techniques of Landing Signal Officers (LSOs) waving pilots land at the ship may need to change. This will necessitate adjustments to pilot skills sets, disrupting long automated muscle memory and decision making for expert pilots and introduce more complex learning for novice pilots due to additional modes.

Exploring the Use of 3D Multi-User Virtual Environment Applications for Military Tasks

The objectives of this effort are to develop a 3D Multi-User Virtual Environment (MUVE) R&D capability and demonstrate the feasibility of the capability utilizing an unmanned air systems use case. A MUVE testbed using gaming technology has been developed.

Environment Designed to Undertake Counter A2AD Tactics Training and Experimentation (EDUCAT^{2}E)

The objectives of this research effort are two-fold. First, it will conduct analysis of multiplatform Electronic Warfare (EW) and Air Defense teams to understand how EW supports Air Defense & define roles/responsibilities, interdependencies, and multiplatform performance metrics. Second, it will define and develop synthetic, scenario based, distributed EW capabilities for Strike Group Electronic Warfare and Air Defense teams that can be used for both training and experimentation. Outputs of this effort will support development of shore-based training technologies enabling training opportunities linked to both Basic and Intermediate Phase certification exercises.



Fleet Adaptive Multilevel Measurement for Operations & Unit Systems (FAM2OUS)

The science and technology of this FNC will focus on developing an assessment architecture that will automatically and adaptively collect, fuse, display, analyze, and archive training data (Live, Virtual, Constructive) from disparate systems. Intelligent performance measurements will be developed using machine learning algorithms that can adjust as the tasks, tactics, and student ability changes. Data fusion techniques will also be used to automatically synthesize data from disparate sources and systems. These data will be stored in a centralized system that will enable rapid development of post-mission and readiness reports.

STRIKE LAB

Simulation and Training Research to Improve Knowledge and Effectiveness

MISSION

Apply cognitive science and human factors engineering to improve warfighter readiness through optimal training and system design. Perform research to improve the instruction implemented in training system in order to maximize learning and/or performance.

EXPERTISE

- Research Psychologists (B.S./M.S./ Ph.D.'s)
  - Applied Experimental & Human Factors
  - Cognitive Psychology
- Computer Scientists(M.S.)

CAPABILITIES

- Instructional Strategies Research
  - Adaptive Training (including Intelligent Tutoring Systems)
  - Types of Feedback
  - Modality of Feedback
- Application of advanced technologies in training systems
  - Automated performance measurement and assessment
  - Game-based training
  - Simulation-based training
  - Virtual and Augmented Reality
  - Human behavioral modeling
- Training effectiveness evaluations
- User interface design and testing

RECENT PROJECTS

Submarine Electronic Warfare Adaptive Trainer (SEW-AT)

Under the Office of Naval Research's Future Naval Capability (FNC) "Scalable Integrated RF System for Undersea Platforms (SIRFSUP)" program, the STRIKE & TechRAT labs are developing an AT system called the Submarine Electronic Warfare Adaptive Trainer (SEW-AT) that aims to improve a submariner's ability to manage an increasingly complex RF environment while maintaining safety of ship. The objective of this project is to develop an on-board adaptive training capability that allows operators to train while deep. In fulfillment of this objective, we have delivered prototype SEW-AT systems to 6 Submarine Learning Center detachments (Bangor, Groton, Guam, Norfolk, Pearl Harbor, and San Diego) and delivered portable SEW-AT systems to 5 submarines. Usage and feedback data collected from these deliveries inform future development and improvements to SEW-AT software.

Electronic Warfare Micro-adaptive Training (EW-MAT)

To help fill gaps highlighted in the Submarine Force Electronic Warfare Wholeness Campaign and the Submarine Tactical Requirements Group, the Office of Naval Research has begun a Future Naval Capability (FNC) to develop an embedded, on-board adaptive training capability. More specifically, the main objectives of this effort are to (1) create micro-adaptive training algorithms, (2) develop a digital signal generator, and (3) evolve the state-of-the-art EW hardware and software to create a common EW framework for undersea, surface, and air platforms. We will collaborate with NUWC Newport and NAVAIR Pax to extend SEW-AT software to create micro-adaptive training algorithms that allow operators to hone their EW skills using on-board tactical system hardware and software.

For More Information Please Contact

NAWCTSD Technology Transfer Program Manager

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STRIKE LAB

Simulation and Training Research to Improve Knowledge and Effectiveness

Adaptive Training for Joint Terminal Attack Controllers

Previous research has demonstrated the potential for AT for military training, but more research is needed to determine which AT techniques to employ, when to employ them, and for what content in order to inform the military training community when to invest in these technologies. The objective of this effort is to conduct a series of experiments to determine which AT techniques are effective for training a complex decision-making task centered on USMC Joint Terminal Attack Controllers (JTAC). In particular, the focus of the training is on game plan development, a critical planning task that sets the stage for the execution of a Close Air Support mission and challenging topic for JTAC trainees to master.

Adaptive Training for Submarine Navigation and Piloting

The goal of this FNC was to develop and demonstrate a validated adaptive training (AT) approach and AT system to enhance submarine training. The Periscope Operator Adaptive Trainer (POAT) was developed in collaboration with NAWCTSD's TechRAT Team to provide training on periscope calls using a novel AT approach based on the science of learning. Several experiments, including a training effectiveness evaluation with submariners, were completed which demonstrated that using POAT led to more efficient and effective training than traditional non-adaptive approaches. POAT has been installed on numerous submarines for on-board training. Several technical publications on this work have been published and the team has received multiple awards for their work on this program.

Examining the Effects of Games Features on Learning in Simulation-based Training

Game-based training techniques hold promise to meet DoD demands for low-cost, realistic, anytime, anywhere training. However, existing research on the effectiveness of game-based training is mixed and often nonsystematic. Despite the lack of research to identify specific game features that lead to better learning and performance outcomes, game-based training systems are already being delivered to the Fleet. The objective of this research is to systematically examine whether specific game features such as score, performance gauges, and competition features increase motivation, task performance, and trainees' willingness to replay the training. To accomplish these research goals, the STRIKE Lab partnered with NAWCTSD's TechRAT Lab who developed different versions of the Periscope Operator Adaptive Trainer testbed with and

Investigating Low-Cost Virtual Reality Technologies and the Role of Gestures on Training Effectiveness

Emerging commercial-off- the-shelf (COTS) products offer an opportunity to make virtual reality (VR) training applications an attractive solution for more learner-centered training. This research investigated the feasibility and limitations of these technology to provide practical and effective training of interest to the Fleet. For this effort, the STRIKE Lab partnered with NAWCTSD's Advanced Gaming Interactive Learning Environment Team who developed a testbed for E-28 arresting gear maintenance training and a mixed reality testbed. The STRIKE Lab performed three human-subjects experiments that explored the impacts of training in an immersive 3D environment with natural interactions versus traditional desktop training (Experiment 1), which feedback modalities are most effective for VR training (Experiment 2), and determining whether training in VR transfers to real-world tasks.

TechRAT LAB

Technology Research Applications Team

MISSION

Provide simulation and media solutions for the undersea warfare, surface warfare, special warfare and naval aviation training communities.

EXPERTISE

- Computer Scientists
- Engineers
- Psychologists
- Graphic Artists

CAPABILITIES

- Augmented Reality/Virtual Reality (AR/VR)
- Instructor and Scenario authoring tools
- Environment authoring tools
- Replay/After action review
- Image generators
- Emulations of tactical/ commercial equipment
- Stimulate tactical/ commercial equipment
- 2D/3D virtual tours
- Native/Web/Tablet
- Interface to external systems
- Adaptive algorithms/training

RECENT PROJECTS

SubSkillsNet and Mariner Skills Suite

SubSkillsNet, and its surface variant, Mariner Skills Suite, are suites of PC-based software applications that offer individual or team training in piloting and navigation, as well as contact coordination. These networked simulations employ a synthetic visual environment and include simulated periscopes, bridge views, and radar and sonar emulations in open ocean or in modeled ports.

A scenario authoring tool allows instructors to compose scenarios with a multitude of variables (e.g. weather, sea state), employing an extensive contact library. Runtime tools provide instructors the ability to challenge their students on the fly with changes in traffic and environmental conditions. An after-action tool allows instructors to evaluate their students' performance after a training session with powerful debrief features.

In addition to the scenario tools, the EDGE tool (Environment Design Generation and Editing) provides instructors the ability to create new simulation environments from standard data sets (DNC, DTED) or edit existing modeled ports. EDGE gives instructors the power to modify navaids, cultural details, foliage, terrain elevation and soundings. The latest version of EDGE stores ocean, terrain, radar and 3D data in a modular storage schema called 'cells.' This enables seamless global coverage and enhanced data management.

For More Information Please Contact

NAWCTSD Technology Transfer Program Manager

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TechRAT LAB

Technology Research Applications Team

SubSkillsNet is on board every US Navy submarine and in electronic classrooms and shore-based trainers at US submarine bases worldwide. Mariner Skills Suite is in use by both the Naval Reserve Officer Training Corps (NROTC) at over 40 universities nationwide, as well as active duty sailors at surface fleet training facilities.

VISIT is a panoramic photography-based virtual tour that allows the user to explore a number of platforms. Current tours include US Navy surface ships, submarines, aircraft and buildings. The DDG 51 version is web-deployed via Navy eLearning and future versions will target mobile devices.

VISIT 3D™ enables trainees to interact in a 3D rendered environment with items of interest to access descriptive or instructional media including: interactive courseware, workstation simulations, reference documents, quizzes, and common media files. Trainees can practice and execute procedures to facilitate basic shipboard and warfare qualifications.

MOVING FORWARD…
As computing technology evolves with an ever stronger emphasis on mobility, so will our product lines, adapting to mobile platforms including Mac iOS, Android devices and Microsoft Surface tablets. Coupled with our research into emerging technologies, including augmented and virtual reality, we'll stand ready to support new training initiatives, such as Sailor 2025.

Trident Training System (TTS) Lab

MISSION

Provide full trainer life cycle support for the Trident Submarine Damage Control Trainer and the Electrolytic Oxygen Generator / Automated Electrolytic Oxygen Generator Simulator (EOG/AEOG) training systems. The lab manages software/systems development, integration test, design, packaging, and fielded updates. It uses an integrated development environment and modular test berth to perform these trainer support functions.

EXPERTISE

- Computer Engineers/Scientists
- Submarine Subject Matter Expert

For More Information Please Contact

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Electrolytic Oxygen Generator

The Electrolytic Oxygen Generator Front Panel Simulator (EOG FPS) is a visual replication of the front panel of a Group I (Ship common) Model 6L16D Electrolytic Oxygen Generator (EOG). The EOG FPS provides for 'hands on" training of EOG operators and selected preventative and corrective maintenance procedures, fault analysis, and troubleshooting procedures on the model 6L16D EOG. It duplicates shipboard modes of operation and performance parameters in order to provide realistic operating conditions and indications. It also provides the capability to simulate the dynamic behavior of the operational equipment, including Pressurization, Electrolysis, Gas Analysis, Shutdown, and Purge functions. This capability allows for the performance of the various fault analysis scenarios and replication of the actual performance of a tactical 6L16D EOG.

Trident Training System (TTS) Lab

Supported Sites:

Groton, CT

San Diego, CA

Pearl Harbor, HI

Norfolk, VA

Kings Bay, GA

Bangor, WA

Automated Electrolytic Oxygen Generator

The AEOGS trainer provides individual hands-on training for operators and technicians on selected preventative maintenance procedures, fault analysis and troubleshooting procedures on the model 6L16E Automated Electrolytic Oxygen Generator (AEOG). The trainer consists of a modified tactical Automated Electrolytic Oxygen Generator Model 6L16E. The AEOGS trainer is not capable of producing gas and requires only electrical power input for control and indications. The AEOGS interfaces with the PC-based Instructor Operator Station (IOS) and associated simulator input/output (SIO) equipment. This provides the trainer with controls and indications that look and operate like the tactical AEOG. A non-functional Cell Area (16 cells) allows trainees to perform required maintenance procedures on the Cells.

Unmanned Systems—Training Experimentation & Simulations (US-TES) Laboratory

MISSION

Provide hardware and software toolsets for use in the research and development of UAS training platforms.

EXPERTISE

- Computer Scientists
- Computer Engineers
- Subject Matter Experts

CAPABILITIES

The US-TES lab provides emerging UxS/UAS technology to NAWCTSD personnel. The lab is comprised of re-configurable user stations, hardware, pre-installed software, and technical expertise to qualified users. System Engineering, Instructional Systems Design, Test and others are able to deep dive into emerging systems without the overhead of operational systems.

The lab maintains RDT&E tools for Human Systems and Training System Solutions in support of UxS/UAS environments. Support NAWCTSD users by providing the needed UxS/UAS hardware and software in a re-usable lab environment to help reduce cost, scheduling and technical risk.

For More Information Please Contact

NAWCTSD Technology Transfer Program Manager

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Unmanned Systems—Training Experimentation & Simulations (US-TES) Laboratory

Supported Projects and Focus Areas

The US-TES lab is configured to host two aircrew stations and two instructor stations. Each individual station is reconfigurable so that it can swap roles and become another aircrew, instructor or admin station if necessary. The laboratory will provide the capability for UAS projects to perform human engineering studies, system requirements analysis, advanced trainer testing, interoperability research, and documentation support and emerging technology analysis. In addition, the laboratory will serve as a research, development and testing center for other training orientated users that may only require access to these tools for a limited time span.

The US-TES lab currently supports the PMA-268 MQ-25 (Stingray) training team. MQ-25 personnel have successfully installed their UMCS Core 1.0 control station software and are using it to help create FAM training for the fleet.

BENEFITS

The lab provides personnel an opportunity for hands on experience with emerging UxS/UAS technologies in-house without the limitations on time and system availability encountered in an operational environment. With the ability of having in-house equipment for NAWCTSD personnel to perform on travel expenses and operational schedules can be reduced. Users that previously had to travel and schedule time on operational systems can now perform tasks in house with greater time on system with increased modification rights. Operational equipment or test ranges no longer have to be shut-down and modified for the NAWCTSD team to perform their job.

HUMAN SYSTEM TECHNOLOGY ROADMAP

Disclaimer: This Human Systems Technology Roadmap is a living document and is subject to change. Significant portions of the information are planning in nature and are subject to change throughout the acquisition planning and acquisition strategy approval process, and in response to peer reviews.

Published By
Naval Air Systems Command
Human Systems Department, AIR 4.6
Rev 28 of 15 Nov 2018

			2016	2017	2018	2019	2020	2021	2022
CC1 - Human Systems Engineering, Integration, and Acquisition	Research, design, and development of integrated Human Systems products	Develop tools and methodologies for deriving and managing SoS requirements			Deploying Mobile Devices for Navy Training (TSD:219SG)				
				Simulation Standards for Interoperability of Human Performance and Debrief Data in Training (TSD: 219:SG)					
		Human performance metrics and training solutions that support Integrated Warfare Capabilities (IWC)			Next Generation Training Systems Development for Manned & Unmanned Concepts				
		SoS/Big Data Human performance analysis tools			A hybrid classification approach using down-sampling techniques and tuned hyper parameters on imbalanced datasets (TSD: 219BAR)				
CC2 - Optimized Human Performance and Decision Support	Human-Machine Interfaces	Enhance collaborative and autonomous unmanned surveillance and strike capabilities	Adaptive Training for Maintaining Attention during UAS Operations (TSD - SBIR N162-090)						
			Identification and Definition of Unmanned Aerial System Air Vehicle Operator Performance Metrics (TSD-219BAR)						
			Unmanned Systems - Training Experimentation & Simulation (US-TES) Lab (TSD-CIP)						
					User Interface Strategies for Human-Machine Team Training in a Simulated Swarm Task (TSD:219BAR)				
			Evaluating Robot User Displays to Investigate Team Effectiveness (ERUDITE) (TSD:219BAR)						
		Enhance data representation and visualization for decision support		Complex-Knowledge Visualization Tool (TSD: SBIR N17A-T004)					
					End-User Speech Recognition Support Tools for Crew Resource Management Training Systems (TSD: STTR N17A-T010)				
		Improve mission planning and real-time re-planning			Pre-FNC Fleet Training Technologies (FleeT2) (TSD: ONR)				
		Provide actionable tactical situational awareness			Aircrew Control of Remote Asset Using an Electronic Kneeboard (UAV ctl with EKB) (PAX-BAR)				
				Application of Virtual / Augmented Reality Systems in Manned and Unmanned Systems HMI (VR-AR TACTICAL HMI) (TSD)					
			Spatial Augmented Reality Training Utilizing a Transparent Display (TSD: WFD SG)						
		Improve manned platform information management and payload, systems, and vehicle control	Impact of Low-Cost Haptic Cueing on User Performance and Workload (TSD:ILIR)						
			Methods for Actionable Measures of Absolute Cognitive Workload (TSD:SBIR)						

			2016	2017	2018	2019	2020	2021	2022
CC2 - Optimized Human Performance and Decision Support	Instructional Strategies for Training Effectiveness	Improve training outcomes through application of neurophysiological data	Construct Correspondence of Physiological and Subjective Measures of Hypoxia (TSD-ILIR)						
			Squad Overmatch (TSD: DHA)						
		Improve warfighter performance through application of psychometric theory		Techniques to Adjust Computational Trends Involved Changing data (TACTIC) (TSD: STTR N17B-T032)					
		Enhanced techniques for individual, team, and multi-team performance assessments	Electronic Warfare (EW) Tactical Decision Aid (TACAID) (TSD-FNC)						
			Squad Overmatch and Team Overmatch – Tactical Combat Casualty Care (TSD-ATD-Joint)						
			Performance Measurement (PM) Engine (TSD-AWTD)						
			Personal Assistant for Life Long Learning (TSD-ONR ADV. TECH.)						
			Training Expansion Package - (TSD: ONR Tech Solutions)						
				Techniques to Adjust Computational Trends Involved Changing data (TACTIC) (TSD: STTR N17B-T032)					
		Develop LVC performance assessment technologies and after-action review strategies		Complex Knowledge Visualization Tool (TSD: STTR N017A - T004)					
					USMC Adaptive Joint Terminal Attack Controller (JTAC) training (ONR)				
				Adaptive Training for USMC Close Air Support Tactics and Decision-Making (ONR30: ATD)					
				FAMOUS (Fleet Adaptive Multilevel Measurement for Operators and Unit Systems) (ONR & PMA205)					
			EDUCATE (Environment Designed to Undertake Counter A2AD Tactics training and Experimentation) (ONR)						
				FleeT2 (Fleet Training Technologies) (ONR34: Pre-FNC)					
				Transition of Crew Role-Player Enabled by Automated Technologies to Maritime Patrol Training (TSD: 219TT)					
				Investigation of Micro-Adaptation Schedules to Support Electronic Support Measures Operator Adaptive Training (TSD: ONR34-D&I)					
			Modular Advanced Technologies Marksmanship Proficiency (MAT-MP) (TSD-Tech. Transfer)						
			Operation Blended Warrior (TSD:IITSEC)						
		Develop data analyses to facilitate trainee feedback and identify novel performance trends	Basic Electronics and Electricity Learning Environment (BEETLE) II Transition (TSD-219TT)						
					Empirical Support for the Benefits of Performance Measurement Tools (TSD-219TT)				
					Data Science Driven Aircrew Performance Measurement and Proficiency System				
		Develop scenario authoring tool sets that use training network assets and integrated training							

			2016	2017	2018	2019	2020	2021	2022
CC2 - Optimized Human Performance and Decision Support	Advanced Instructional Techniques	Integrate instructional interventions into virtual and mixed reality environments	Investigating Low-Cost Untethered Virtual Reality Technologies and the Role of Affordances on Training Effectiveness in an Immersive Environment (TSD-219BAR)						
					Distributed Virtual Reality Testbed (TSD: WFD:SG)				
			Accelerating the Development of Small Unit Decision Making (ADSUDM) (TSD-FNC)						
			Naval Integrated Fire Control- Counter Air (NIFC-CA X) Mission Visualization Tool (TSD-FNC)						
				Mishap Awareness Scenarios and Training for Operatonal Readiness Responses (TSD: SBIR)					
			Sexual Assault Prevention and Response (SAPR) Virtual Immersive Training (TSD: DoN SAPR Office)						
				Dynamic Flight Simulation as a Supplement to In-Flight Pilot Training (TSD: SBIR N08-012)					
		Develop methods to diagnose and deliver instructional interventions to remediate knowledge and skill deficiencies	Post Mission Assessment for Tactical Training & Trend Analysis (PMATT-TA) (TSD-AWTD)						
					Repurposing Computational Analyses of Tactics for Training Assessments				
			Systematic Team Assessment of Readiness Training (START) applied to Medicine: Medic/Corpsman Proficiency Model (MED-PM) (TSD-DoD S&T)						
			Augmented Training for Experiential Learning for Signal Officers (TSD-219TT)						
			Tutoring Effectively: An Assessment of Common Heuristics (TEACH) (TSD-ONR D&I)						
			Electronic Warfare (EW) Tactical Decision Aid (TACAID) (TSD-FNC)						
			Personal Assistant for Life Long Learning (TSD-ONR ADV. TECH.)						
				Learning Continuum and Performance Aid (LCaPA - ONR FNC)					
			Measuring Intuition and its Relationship to Somatic Markers and Indivdual Differences (TSD: ILIR)						
					Team-Based Advanced Resilience Accelerator (TARA) (TSD: AWTD)				
		Employ game-based training to improve performance	Examining the Effects of Game Features on Learning Scenario Based Training (TSD-BAR)						
			Research Exploring Multi Operator Training Environments (REMOTE) (TSD-WFD:SG)						
		Develop mobile training technologies	Effectiveness assessments of mixed and immersive reality for aviation training (SBIR N171-201)						
					Deploying Mobile Devices for Navy Training: Low Cost Mobile Device Management Alternatives (TSD-WFD:SG)				
					Proximal Engagement Education Resources (TSD: ONR - STEM)				

			2016	2017	2018	2019	2020	2021	2022
CC2 - Optimized Human Performance and Decision Support	Applied Human Behavior Modeling	Develop computational models of human performance	Maintainer – Proficiency Model (MAIN-PM) (TSD-BAR)						
				Decision Making for Human Machine Collaboration in Complex Environments (ONR Basic Research Challenge)					
		Develop standards for verification, validation, and accreditation (VV&A) of human performance models							
		Develop Semi-automated Forces (SAF) models with human-like performance	CREATE (Crew Role Player Enabled by Automated Technology Enhancement) (SBIR N14-2-090) & CREATE for Maritime Patrol Training (219TT-18-003 - PMA-290)						
					Transition of Crew Role-Player Enabled by Automated Technologies to Maritime Patrol Training (TSD: 219TT)				
					Adjustable Crewmembers - Accelerating Instructor Mastery (AIM) - SBIR N152-108				
			DYADEM (Dynamic Adaptive and Modular Entities for UAS) behavior models for UASSIST (also in CC3)						
			Tactics and Speech Capable Semi-Automated Forces (TACSAF) (ONR LVC FNC)						
				V&V of higher fidelity constructive entities (TSD: LVC SV)					
CC3- Advanced Training Systems Technologies	High-Fidelity Training Environments	Create repository of assets and metrics to design and maintain high-fidelity trainers							
		Develop real-time flight aerodynamic and visual simulation technologies	3D Interactive Aircraft Carrier Operations Planning Tool Prototype (TSD-BAR)						
			Virtual Environment Motion Fidelity Model (TSD-BAR)						
				Effective Measures of Training Display System Performance (TSD-SBIR: N142-104)					
					Extended Field of View (FOV) Video Aviation Training Aids (PAX)				
				Flight Deck Crew Refresher Training Expansion Packs (TEP) (TSD: ONR Tech Solutions					
				Dynamic Flight Simulation as a Supplement to In-Flight Pilot Training (TSD: SBIR N08-012)					
			Innovative Collimated Displays (TSD: SBIR N121-041)						
				Small Projector Array Display System (TSD: SBIR N121-041)					
				Variable Accomodaton Head Mounted Display					

			2016	2017	2018	2019	2020	2021	2022
CC3- Advanced Training Systems Technologies	High-Fidelity Training Environments	Advanced Training Systems Prototypes	Immersive Parachute Descent Procedure, Malfunction and Decision Making Training System (TSD: SBIR N161-007)						
					Transition of a Pressure on Demand Normobaric Hypoxia Training device for Survival School Houses (TSD: 219BAR)				
			Mask-on Hypoxia Training Device (TSD SBIR N132-093)						
					H-60R VR ATO Weapons Procedures Trainer prototype (TSD: G0)				
					NIFC-CA X Laptop Trainer (TSD)				
					Bohemia VR F/A-18 PTT VFA-106 eval (TSD: CRADA)				
					Course Rules Part Task Trainer Study (PMA205: AWTD)				
					H60S VR HDTS Trainer (TSD: 219-RPC)				
					Fire Fighting Trainer Modification and Enhancement (SWOS)				
					Aviation Reconfigurable Cockpit for Hypoxia & Hazard Exposure & Recognition (ARCH2ER)				
					Oceanography Tactics Training for Employment Readiness				
		Develop speech recognition, synthesis functionality, and computational methods to recognize the difference between relevant and irrelevant speech		End-User Speech Recognition Support Tools for Crew Resource Management Training Environments (TSD: STTR)					
		Develop multi-modal sensory simulation systems and integrate into Tactical Software training applications		Spatial Augmented Reality Training Utilizing a Transparent Display (TSD:219SG)					
					Exploration of Kinesthetic and Haptic Technologies in Virtual Training Environments				
					11F12 Catapult Launch System Trainer Replacement (TSD: PMA 205)				
		Develop multi-touch interaction and 3D models		Flight Deck Crew Refresher Training Expansion Packs (TEP) (TSD: ONR Tech Solutions					
					Exploration of Kinesthetic and Haptic Technologies in Virtual Training Environments				

			2016	2017	2018	2019	2020	2021	2022
C3- Advanced Training Systems Technologies	Simulation Interoperability and Distributed LVC Technology	Develop interoperable LVC and Cyber Warfare training simulation and technologies	Crew Role Player Enabled by Automated Technology Enhancements (CREATE) (TSD-SBIR:N142-090)						
			Environment Designed to Undertake Counter A2AD Tactics Training & Experimentation (EDUCAT2E) (TSD-FNC)						
			Network Effects Emulation System (NE2S) (TSD-BAR)						
				Integrated Warfighting Capabilities (IWC) Fidelity Investigation (TSD-BAR)					
			Live, Virtual & Constructive (LVC) Training Fidelity (TSD-FNC)						
					Real-Time RF Propagation Modeling in Urban Environments for Virtual and Constructive Training(TSD-BAR)				
					Verification and Validation of Higher Fidelity Constructive Entities for UAS Training (TSD-BAR)				
					Distributed Virtual Reality Testbed (TSD: WFD:SG)				
				Cyberspace Operations Degraded Exercise & Synthetic Training Architecture (CODESTAR) - ONR34					
		Develop Multi-Level Security Methods to safeguard classified information in the LVC environments			Enterprise Network Guard (ENG) CT&E - NSA certification test and evaluation (TSD: LVCt)				
					Enterprise Network Guard (ENG) TENA and HLA extension efforts - FY18 and FY19 (TSD: LVCt)				
			Distributed Training Network Guard (DTNG) (AWTD: JSF)						
					Multi-Intergrated Domain Administrative Support Solution				
		Develop Mission Rehearsal Enabled Database Methods for collecting and packaging authoritative data feeds	Distributed Synthetic Environment Correlation Architecture and Metrics (TSD-SBIR:N141-006)						
		Develop tools for Enhanced Constructive Environments	Cross Domain Maritime Surveillance and Targeting (CDMAST) (TSD-DARPA)						
			Dynamic Adaptive and Modular Entities for UAS (DYADEM) (TSD-FNC)						
		Develop Information Load Management methods, technologies, and tools							
		Develop Navy Continuous Training Environment (NCTE) voice communication technologies to support FST exercises for distributed environments							

			2016	2017	2018	2019	2020	2021	2022
CC4 - Human Systems Analysis, Design, and Evaluation	Content Design	Develop advanced technologies and methodologies for training delivery		Utility and effectiveness of using Fleet produced maintenance videos as job performance aids (219BAR-18-049)					
				Spatial Augmented Reality Training Utilizing a Transparent Display (TSD:219SG)					
				Advanced Instructional Media Attribute and Interactivity Model (Sailor 2025; FY17-18+)					
				Explosive Ordnance Disposal maintenance videos effort					
				Multi-media Knowledge Capture (MKC) Engine (SBIR ONR181-111)					
					Total Learning Architecture (TLA) Learning Technology Roadmap with Concept Pilots (DHA: Applied Res.)				
				Defense Health Agency (DHA) Total Learning Architecture (TLA) Learning Technology Roadmap with Concept Pilots					
	Training Optimization Analysis	Optimize training event sequencing and media utilization	Medical Training Validation 2 (MTV2) (TSD - DOD S&T)						
					Investigation of Training Fidelity for Carrier Qualification and Precision Landing Modes (TSD: 219BAR)				
		Develop Improved Tools and Techniques for Training Requirements Analysis	Requirements Traceability Tool /Systems Engineering Test Tool (RETT / SETT)						
			MEDPM (Medical Proficiency Measurement Model) (DHA)						
	Training Effectiveness Evaluation (TEE)	Determine level of training effectiveness and outcome improvement strategies	Multi-purpose Reconfigurable Training System (MRTS) Effectiveness (TSD Overhead)						
			Effectiveness Assessments of Mixed & Immersive Reality for Aviation Training (TSD:SBIR N171-021)						
					Course Rules Part Task Trainer Study (PMA205; AWTD)				
				Office of Naval Research Technology Candidate: NOTORIOUS					
				Investigation of Training Fidelity for Carrier Qualification and Precision Landing Modes					

			2016	2017	2018	2019	2020	2021	2022
CC5 - Warfighter Protection, Performance and Survivability	Determine Injury Mechanisms	Develop models to correlate excessive noise/laser exposure with hearing/eye damage							
		Injury cause and epidemiology – operations, maintainers, bad day scenarios							
		Develop life support systems (LSS) to protect against environmental stresses	Mask-on Hypoxia Training Device (TSD SBIR N132-093)						
		Develop LSS to protect against ballistic, directed energy, CBRN and vision threats							
		Develop technologies to monitor human physiologic response and LSS functionality							
		Develop enhanced research protocols to determine LSS effectiveness to support cognitive and physiologic response against military relevant threats	Construct Correspondence of Physiological and Subjective Measures of Hypoxia (ILIR-17-004)						

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